A Comprehensive Water Quality Monitoring Program Strategy for California

Recommendations of the

California Water Quality Monitoring Council

submitted to

Linda S. Adams

Secretary for Environmental Protection

and

Lester Snow

Secretary for Natural Resources

State of California

September 23, 2010 DRAFT

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by Jon B. Marshack

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Foreword

The purpose of this report of the California Water Quality Monitoring Council is to lay out a comprehensive monitoring program strategy for California, a ten-year plan to achieve ambitious goals related to the design and implementation of water quality and associated ecosystem monitoring programs, the use of monitoring data in assessments and decision making, and the development of tools and supporting infrastructure to enable wide access to data and information products.

The Problem

Many local, state, and federal agencies, regulated dischargers, volunteer monitoring groups, and hundreds of water bond grant recipients spend millions of dollars each year collecting water quality and associated ecosystem data in California. These data must be turned into useable information to help decision makers and stakeholders understand the status of our waters and aquatic ecosystems, public health and welfare issues related to water quality, and the effectiveness of agency programs to manage our water resources.

But California's water quality information system is defective. Because current monitoring programs were developed to address site-specific issues or to fulfill different statutory or regulatory compliance mandates, there are inconsistent monitoring objectives and methods to collect and assess the data, making it impossible to integrate data from different studies to develop valid information. And there is no single user-friendly place to access the data. There is a tremendous opportunity for improvement.

In response, State Senate Bill 1070 (Kehoe) was signed into law in 2006, requiring the California Environmental Protection Agency (Cal/EPA) and the California Natural Resources Agency to establish, through a Memorandum of Understanding (MOU), the California Water Quality Monitoring Council. As approved by the two Agency Secretaries, members of the Monitoring Council (see inside front cover) represent state regulatory and resource management agencies, the regulated community, water supply interests, citizen monitoring groups, the scientific community, and the public. The breadth of representation on this council is unique.

SB 1070 required that by December 1, 2008 the Monitoring Council report its recommendations for maximizing the efficiency and effectiveness of existing water quality data collection and dissemination, and for ensuring that collected data are available for use by decision makers and the public. Those initial recommendations were submitted to the Agency Secretaries for Environmental Protection and Natural Resources.

The Monitoring Council's Vision

Rather than focusing on technical details, such as methods consistency and standard data formats, the December 2008 recommendations presented a new solution. The Monitoring Council believes that the best way to coordinate and enhance California's monitoring, assessment and reporting efforts is first to provide a platform for intuitive, streamlined access to water quality information that directly addresses users' questions. Theme-specific workgroups, under the overarching guidance of the Monitoring Council, evaluate existing monitoring, assessment and reporting efforts and work to enhance those efforts so as to improve the delivery of water quality information to the user, in the form of theme-based internet portals.

Each portal is developed and maintained by a theme-specific workgroup, staffed by issue experts representing key stakeholders for their specific theme. Each workgroup coordinates existing monitoring programs within their theme, developing monitoring and assessment methods and data management procedures according to performance measures defined by Monitoring Council. The goal is to achieve only the degree of standardization necessary to meet users' needs. The Monitoring Council establishes common policies and guidelines for the workgroups and the monitoring programs they represent; and acts as a clearinghouse for standards, guidelines, and collaboration.

"My Water Quality" Internet Portals

To illustrate its vision, the Monitoring Council and its workgroups are developing the *My Water Quality* website (www.CaWaterQuality.net) to provide a single, global access point to a set of theme-based internet portals for water quality monitoring data and assessment information. The website is designed around intuitively clear questions that are readily understood by decision makers, agency managers, legislators, scientists, and the public:

- Is our water safe to drink?
- Is it safe to swim in our waters?
- Is it safe to eat fish and shellfish from our waters?
- Are our aquatic ecosystems healthy?
- What stressors and processes affect our water quality?

Each question leads to a series of web pages that provide map-based access to summary assessment products and more detailed monitoring data that address more detailed questions. Links along the left-hand side of each page enable users to access technical information specific to each theme.

- The Safe to Swim portal initially focuses on Coastal Beaches, Bays & Estuaries. The Beach Water Quality Workgroup and the Central/Northern California Ocean and Bay Water Quality Monitoring Group coordinate the monitoring efforts of state and local agencies and coastal dischargers, and the assessment efforts of regional environmental interests. These data and a variety of assessment tools are included in this web portal, released to the public in July 2009.
- The Safe to Eat Fish and Shellfish portal initially focuses on sport fish. The Bioaccumulation Oversight Group is a collaborative effort of a number of state agencies and others to assess the accumulation of pollutants, such as mercury and legacy pesticides, in fish that people eat. A portal based on their work was released in December 2009.
- Aquatic ecosystem health information is presented in separate portals for each water body type. The first Aquatic Ecosystem Health portal focuses on Wetlands. The California Wetland Monitoring Workgroup coordinates the efforts of twenty three state, federal, and local organizations to assess the extent and health of California's wetlands. Their California Wetlands portal was released in March of this year.
- The Safe to Drink portal initially focuses on groundwater quality. The Water Boards' Groundwater Ambient Monitoring and Assessment (GAMA) program currently gathers groundwater quality data from a variety of state and federal agencies for comparison with drinking water standards, as displayed through their GeoTracker GAMA map-based

information tool. The Safe to Drink portal, based on this tool, was released in October of this year.

Other workgroups are organizing to develop additional portals. The Healthy Streams Partnership is developing a Stream and River Ecosystem Health portal. The Multi-Agency Rocky Intertidal Network is developing a Marine Rocky Intertidal Ecosystem section of a future Ocean Portal. An Estuary Health Portal is also being considered, initially focusing on the San Francisco Bay-Delta estuary.

The *My Water Quality* portals provide tremendous opportunities and benefits. The four initial portals represent a tremendous accomplishment, developed with scant resources and largely volunteer efforts. They

- deliver answers to the public about our water quality and aquatic ecosystems in a manner easy to understand;
- provide the opportunity to highlight the important work of the agencies and organizations involved;
- permit broader-based assessments than were heretofore possible; and
- automate the annual reporting efforts of governmental organizations by focusing on meaningful environmental outcomes.

The Monitoring Council's vision and initial portals have been presented in briefings to Secretary for Environmental Protection Linda Adams, Secretary for Natural Resources Lester Snow, and key legislative staff. All have been highly supportive and encouraged the Monitoring Council to proceed with implementation.

The four prototype web portals developed during 2009 and 2010 demonstrate that the Monitoring Council's approach furnishes both the structure and the motivation for more efficiently addressing technical issues such as data formats and methods standardization. It has fostered the organization of several issue-based collaborative workgroups based on partnership among multiple entities with a common interest in a particular issue. Using this experience as proof of concept, the Monitoring Council recommends the comprehensive water quality monitoring program strategy for California that is presented below.

Legislative Mandates and Agency Agreements

SB 1070 and the November 26, 2007 MOU between the Secretaries for Environmental Protection and Natural Resources task the Water Board, in coordination with the Monitoring Council, with developing a statewide comprehensive monitoring program strategy. Specifically, California Water Code Section 13181(a) states, in part:

> (4) The monitoring council shall review existing water quality monitoring, assessment, and reporting efforts, and shall recommend specific actions and funding needs necessary to coordinate and enhance those efforts.
>
> (5) (A) The recommendations shall be prepared for the ultimate development of a cost-effective, coordinated, integrated, and comprehensive statewide network for collecting and disseminating water quality information and ongoing assessments of the health of the state's waters and the effectiveness of programs to protect and improve the quality of those waters.
>
> (B) For purposes of developing recommendations pursuant to this section, the monitoring council shall initially focus on the water quality monitoring efforts of state

agencies, including, but not limited to, the state board, the regional boards, the department, the Department of Fish and Game, the California Coastal Commission, the State Lands Commission, the Department of Parks and Recreation, the Department of Forestry and Fire Protection, the Department of Pesticide Regulation, and the State Department of Health Services.

(C) In developing the recommendations, the monitoring council shall seek to build upon existing programs rather than create new programs.

(6) Among other things, the memorandum of understanding shall describe the means by which the monitoring council shall formulate recommendations to accomplish both of the following:

(A) Reduce redundancies, inefficiencies, and inadequacies in existing water quality monitoring and data management programs in order to improve the effective delivery of sound, comprehensive water quality information to the public and decisionmakers.

(B) Ensure that water quality improvement projects financed by the state provide specific information necessary to track project effectiveness with regard to achieving clean water and healthy ecosystems.

California Water Code Section 13181(e) states, in part

In accordance with the requirements of the Clean Water Act (33 U.S.C. Sec. 1251 et seq.) and implementing guidance, the state board shall develop, in coordination with the monitoring council, all of the following:

(1) A comprehensive monitoring program strategy that utilizes and expands upon the state's existing statewide, regional, and other monitoring capabilities and describes how the state will develop an integrated monitoring program that will serve all of the state's water quality monitoring needs and address all of the state's waters over time. The strategy shall include a timeline not to exceed 10 years to complete implementation. The strategy shall be comprehensive in scope and identify specific technical, integration, and resource needs, and shall recommend solutions for those needs so that the strategy may be implemented within the 10-year timeframe.

. . .

(4) Methodology for compiling, analyzing, and integrating readily available information, to the maximum extent feasible, including, but not limited to, data acquired from discharge reports, volunteer monitoring groups, local, state, and federal agencies, and recipients of state-funded or federally funded water quality improvement or restoration projects.

(5) An accessible and user-friendly electronic data system with timely data entry and ready public access via the Internet. To the maximum extent possible, the geographic location of the areas monitored shall be included in the data system.

. . .

(7) An update of the state board's surface water ambient monitoring program needs assessment in light of the benefits of increased coordination and integration of information from other agencies and information sources. This update shall include identification of current and future resource needs required to fully implement the coordinated, comprehensive monitoring network, including, but not limited to, funding, staff, training, laboratory and other resources, and projected improvements in the network.

The MOU established the following Monitoring Council responsibilities for carrying out the mandates of SB 1070:

In an effort to: 1) reduce redundancies, inefficiencies, and inadequacies in existing water quality monitoring and data management programs in order to improve the effective delivery of sound, comprehensive water quality information to the public and

> decisionmakers; and 2) ensure that water quality improvement projects financed by the state provide specific information necessary to track project effectiveness with regard to achieving clean water and healthy ecosystems, the Monitoring Council responsibilities under this MOU include, but are not limited to, the following:
>
> . . .
>
> 3. Review existing water quality monitoring, assessment, and reporting efforts and recommend specific actions and funding and staffing levels necessary to coordinate and expand those efforts, as needed, to create an ongoing assessment of the health of the state's waters and the effectiveness of programs to protect and improve the quality of those waters. The Monitoring Council shall initially focus on the efforts of state agencies. The Monitoring Council should build on existing efforts that have successfully achieved key objectives of SB 1070 on statewide or regional scales, promote new information management technologies that could facilitate data integration and sharing, and identify key circumstances where a convergence of interests among agencies provides an opportunity for leverage that could accelerate progress toward the SB 1070's objectives.

Pursuant to these mandates and responsibilities, the Monitoring Council—including its agency representatives from Cal/EPA and Natural Resources—developed the recommended comprehensive monitoring program strategy in coordination with the Surface Water Ambient Monitoring Program (SWAMP) and other Water Board staff. This document is the culmination of that effort.

The Role of SWAMP

SWAMP has played a key role in the development of the Monitoring Council's vision and is poised to be a significant player in the issue-specific workgroup and portal development structure. As quoted above, California Water Code Section 13181(e)(7) requires an update of the SWAMP needs assessment, in light of the coordination provided by the recommended comprehensive monitoring program strategy. To address this mandate, SWAMP has revised its *Monitoring and Assessment Strategy and Assessment Framework* (see Appendix 5), adjusting the program's focus to monitoring and assessment of water body types and beneficial uses that have been the forte of SWAMP activities to date. In addition, SWAMP has developed numerous tools and assistance mechanisms that will aid workgroups that address the water body types and beneficial uses not covered by SWAMP.

Strategy Implementation

The MOU also established responsibilities for the two Agencies:

> This MOU cannot be successfully implemented without the cooperation and involvement of numerous state agencies, boards, commissions, conservancies, and departments. The Secretaries for Cal/EPA and Resources will oversee the implementation efforts of this MOU. This MOU focuses on agency programs within Cal/EPA and Resources. Key programs located within the Department of Public Health should be included with the agreement of the Executive Director of the Department of Public Health. Once the basic infrastructure for implementing the MOU has been established, additional monitoring and assessment programs may be considered.
>
> Under this MOU, the responsibilities of the Secretaries of Cal/EPA and Resources (collectively "the Secretaries") include, but are not limited to, the following:
>
> 1. The Secretaries will direct their boards, departments, and offices to establish and cooperatively participate in the Monitoring Council for improving integration and

coordination of water quality and related ecosystem monitoring, assessment, and reporting.

2. The Secretaries will establish policies and procedures to ensure that water quality improvement projects, including bond-funded grant projects financed by the state, include the ability to track project effectiveness with respect to specific water quality and ecosystem health.

The Monitoring Council is poised to help guide implementation wherever possible, but lacks direct authority to implement the comprehensive monitoring program strategy. Clearly, the responsibility for implementing the strategy falls to the California Environmental Protection Agency and the California Natural Resources Agency, including the allocation of necessary resources. Agency action is vital to the success of this strategy. High-level management support will be needed, including broad-based organizational involvement and conflict resolution. On funding, it has become apparent that seed money is needed to get coordination going (i.e., workgroup formation) and to fund initial portal development. To date, such funding has largely been provided by SWAMP and the U.S. Environmental Protection Agency (USEPA). A similar funding commitment is needed from organizations within the Natural Resources Agency.

Chapter 1: Introduction

The Monitoring Council has spent the 20 months since the release of its December 2008 recommendations (CWQMC 2008) implementing the first steps called for in that report, empirically testing the assumptions underlying those recommendations, and preparing the technical and institutional infrastructure needed for their full implementation (see Appendix 2 of the Monitoring Council's first Annual Progress Report (CWQMC 2009)). Four prototype web portals have been developed and been made available for public access on the Monitoring Council's portal website (www.CaWaterQuality.net), focusing in order on:

- Swimming safety at beaches (Safe to Swim)
- Human health risk associated with sportfish consumption (Safe to Eat Fish and Shellfish)
- Drinking water safety, with a focus on groundwater (Safe to Drink)
- Aquatic ecosystem health, with a focus on wetlands status (Wetlands)

The Monitoring Council found a generally high level of enthusiasm for the web portal concept among parties both inside and outside state agencies and had little difficulty establishing productive partnerships with data sources, users of assessment products, and scientists directly involved in the analysis and interpretation of monitoring data.

Developing these web portals showed that the Legislature was correct in its assessment of the status of water quality and associated ecosystem monitoring programs and data. There is a clear need for a body such as the Monitoring Council to fulfill a coordinating role and to ensure access to coordinated data and statewide assessment products. This necessarily involves more than the assembly of data and connections between databases, although this is essential; it also requires developing assessment questions, methods, and products at the statewide level that respond to a variety of users' questions and perspectives. The process of developing these proof-of-concept web portals has also validated key assumptions underlying the Monitoring Council's core philosophy and confirmed the gains in efficiency of analysis, performance assessment, and reporting possible from the portal approach.

Developing the prototype portals also enabled the Monitoring Council to establish a functioning workgroup structure and define the core elements of the infrastructure (both institutional and technical) needed to support complete implementation of the December 2008 recommendations (CWQMC 2008) over the longer term. These accomplishments provide the empirical basis for the Monitoring Council's recommendations, presented in the following chapters, for moving forward with the ten-year Comprehensive Monitoring Program Strategy called for in the statute.

1.1 The Monitoring Council's approach clarifies the problem

SB 1070 (Kehoe, 2006)described a number of problems that hamper the ability of managers, scientists, and the public to find, access, and use water quality and related ecosystem monitoring data and results. While these problems are widely acknowledged, attempts to solve them have had only limited success because of the diversity of monitoring programs and organizations conducting monitoring, the sheer volume and variety of data they produce, and the number of databases and data systems in which data are stored. In particular, the absence of clear user-driven questions has made it more difficult to develop a useful analysis of data integration and access problems.

In contrast, the web portal that addresses the core question: Is it safe to swim in our waters? (and secondary questions such as: How clean was my beach, lake, or stream during the past month?) provides the context needed to effectively evaluate and then resolve coordination and access problems. The construction of the web portal motivated the Monitoring Council and its "Safe to Swim" workgroup to expand and then organize their knowledge about monitoring programs that focus on this question. As a result, the workgroup has a much clearer picture (Figure 1) of (1) the major sources of data available to answer this question statewide, (2) which data are currently not in databases that can readily be accessed by the web portal, and (3) which assessments are not produced in a timely enough manner to be useful to portal users. Similarly, attempting to apply assessment methods statewide compelled both the Wetlands and Safe to Swim workgroups to explicitly confront inconsistencies in monitoring designs and data aggregation methods that diminished the statewide applicability of assessment results.

Scientists and managers involved with these monitoring programs had long been aware of these data gaps and inconsistencies and, to be fair, these issues have not prevented individual programs from meeting their objectives. However, without the goal of producing statewide assessments and a mechanism for integrating and displaying information at this scale, there was little motivation (or need) to improve data access or coordination.

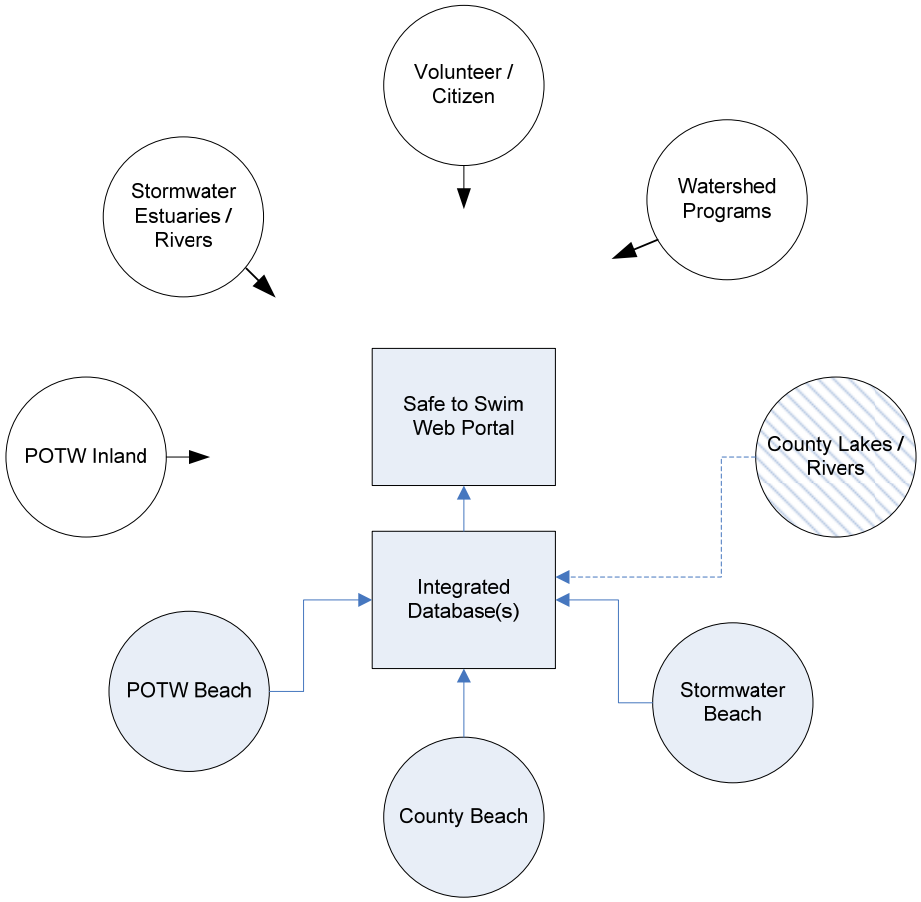


Figure 1. Schematic of the categories of monitoring programs that produce data relevant to the Safe to Swim web portal. Past efforts at bringing monitoring data together in an integrated

statewide database have focused on ocean beaches, and a few county-level monitoring programs at lakes and rivers. Data from other significant inland freshwater monitoring efforts have yet to be addressed. The workplan for this theme therefore includes efforts to incorporate data flows from these remaining program types into the web portal.

1.2 Web portals foster solutions and improve efficiency

The process of constructing the web portals requires scientists and managers to collaborate on articulating meaningful assessment questions that are both useful to managers and the public and based on credible science. This collaboration, combined with the Monitoring Council's design principles for the web portals, fosters creative problem solving that makes use of a wider range of insights, tools, and resources than are available strictly within individual state agencies. For example, the Safe to Swim workgroup has proposed a streamlined and accelerated data management and reporting pathway that makes greater use of technical resources at one of the regional data centers, while both the Wetlands and Safe to Eat Fish and Shellfish web portals incorporate mapping features developed by outside partners.

As the web portals continue to develop, they will enable state agencies to dramatically improve the accuracy and efficiency of many of their routine and ad hoc reporting functions. Quicker access to data and assessment products, combined with query and reporting tools built into the web portals, will make it much easier to respond to questions from the Legislature, agency managers, and the public. Such gains in efficiency have been identified in the Statewide Data Strategy Report, released in July 2009 by the Office of the Chief Information Officer, as one of the major benefits of improved data integration. Even the prototype web portals developed this year by the Monitoring Council have already begun to demonstrate how such dividends can be achieved. For example, the State Water Resources Control Board is planning to use automated outputs from the web portals in annual performance reporting requested by its Office of Research Planning and Performance. And the Safe to Eat Fish and Shellfish web portal makes it possible to quickly create customized assessment products, at scales from individual lakes to the entire state, using monitoring and assessment results that were previously available only from separate databases, agency reports, and agency websites, and only as static products. The web portals provide the more powerful ability for users to choose among, or define, multiple perspectives that suit their particular information needs.

1.3 Implementing the Monitoring Council's Recommended Comprehensive Monitoring Program Strategy

In its first two years of effort, the Monitoring Council has accomplished its primary purpose – to provide the empirical basis for developing clear recommendations for the Comprehensive Monitoring Program Strategy called for in the Statute. The following sections of this report describe the Monitoring Council's core philosophy and approach (Chapter 2), which is fundamental to the success of the ten-year implementation plan (Chapter 3). Implementation will require:

- Further developing the four initial prototype web portals
- Initiating three additional ecosystem health-related web portals already identified
- Expanding outreach to new partners, both within state agencies and outside of state government, and their inclusion in both existing and new theme-based workgroups
- Identifying the next set of priorities for portal development
- Adapting lessons learned from the 2009 effort to the Monitoring Council's plans and procedures

- Designing and implementing the more permanent technical and institutional infrastructure needed to support this expanded and ongoing effort

Chapter 2: Philosophy and Approach

The Monitoring Council's primary vision is that the creation of broader and more streamlined access to monitoring data and statewide assessment products through a set of theme-based web portals provides the catalyst to improve the efficiency and effectiveness of California's water quality and associated ecosystem monitoring and assessment programs. A fundamental element of this vision is the philosophy that the theme-based web portals themselves are central to the success of efforts to improve access and create statewide assessment frameworks. As validated by the prototypes developed during 2009 and 2010, creation of the web portals promotes and organizes critical improvements in monitoring, assessment, and reporting that are impossible to achieve in a strictly bottom-up effort focused only on technical coordination. This philosophy provides an essential foundation for each element in the Monitoring Council's five-part approach to achieving the goals set by the Statute.

2.1 A philosophy of transparent, continual improvement

The Monitoring Council has established an operating philosophy that defines the complementary roles of the Monitoring Council and the theme-based workgroups, working within an overall context of transparent and continual improvement. As described more fully in Section 2.2.1 (A Flexible Organizational Structure), the Monitoring Council plays a role made up equally of leadership, coordination, and support, while the theme-based workgroups are responsible for the majority of the technical work involved in coordinating monitoring, developing assessment methods, and developing the portals themselves.

For the web portals to work as intended, they must meet all six performance measures described below in Section 2.2.2 (Performance Measures). In order to meet the performance measures, the Monitoring Council has identified the following principles as key elements of its operating philosophy:

- Constantly evolving data, technology, and management information requirements mean that the web portals will never be completely "finished" or "perfect"
- The best way to ensure web portals are as responsive as possible to current requirements and constraints is to be as open as possible about the strengths and shortcomings of the web portals and the data and assessment methods on which they are based (see Sections 1.1 and 1.2 above)
- The Monitoring Council itself should play a central role in critiquing the web portals, and their underlying monitoring and assessment programs, and in facilitating plans for their continual improvement
- Such transparency builds credibility and encourages the involvement of the partners needed to continue developing and improving the web portals and their underlying monitoring and assessment programs
- The web portals should provide the framework to both motivate and guide the effort needed to correct problems and develop enhanced capabilities

Organizations whose success is critically dependent on innovation, high quality, and/or high reliability explicitly cultivate just such a culture of open and transparent self-criticism and continual improvement. The Monitoring Council's central role in this process is illustrated in Figure 2.

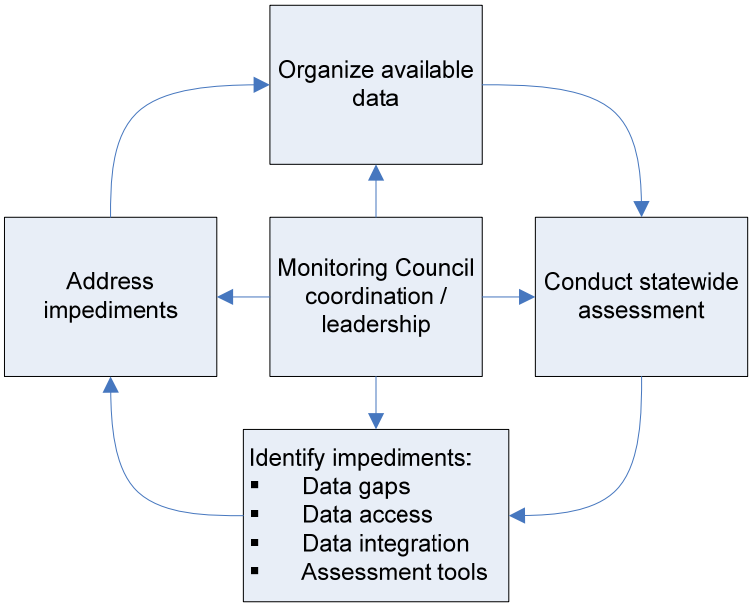


Figure 2. The Monitoring Council's central role in promoting and organizing a process of continuous improvement in statewide assessments.

2.2 A five-part approach to assessment and data integration

The Monitoring Council (CWQMC 2008) described a five-part solution essential to achieving its vision of broader data access through theme-based web portals. While these five elements remain central to the Monitoring Council's approach, the practical experience gained since then (CWQMC 2009) has added detail and texture to the original concept of how these elements would function together. The five elements are listed here, followed by more detailed descriptions of how the Monitoring Council conceives them to operate after 20 months' experience:

- An organizational structure built on decentralized, issue-specific workgroups that operate within common policies and guidelines defined by the Monitoring Council
- A set of performance measures which each theme-based workgroup will use to evaluate, coordinate and enhance monitoring, assessment, and reporting efforts. These performance measures are adapted from USEPA's 2003 report *Elements of a State Water Monitoring and Assessment Program* (USEPA 2003) and map directly onto the ten EPA elements as described in CWQMC (2008)
- A single, global point of entry to water quality data, and a design template for the complete set of theme-based web portals
- Coordination[1] of monitoring and assessment methods that achieves an appropriate balance between statewide consistency and regional flexibility

[1] The CWQMC uses the term "standardization" to refer to the use of identical methods. In contrast, "coordination" refers to the use of methods that, while technically different, produce comparable results that provide the basis for data integration, comparisons across programs, and larger-scale and more complex assessments. Given the effort required to develop, promulgate, and maintain standardization, and the large number of partners involved in the web portals, the Council has opted for coordination. Standardization will be used as a final resort where coordination cannot produce the needed degree of comparability.

- Database and data management practices necessary for more efficient data access and integration

There is a crucial difference between the Monitoring Council's approach and past efforts to provide improved data access and coordination. The Monitoring Council will not simply link to monitoring databases and encourage the more widespread use of standards. Rather, the Monitoring Council will use improved data access and coordination as the basis for conducting higher-level syntheses and assessments at the statewide level. The ready availability of statewide data will enable the Monitoring Council to task its workgroups with developing and applying statewide performance assessments that in the past could not be conducted because of problems like that illustrated in Figure 1.

2.2.1 A flexible organizational structure

The Monitoring Council has established an organizational structure based on theme-specific workgroups operating within common policies and guidelines established by the Monitoring Council. The Monitoring Council will either pose the core assessment questions itself or review and sign off on questions developed by the workgroup. This is a critical initial step because the assessment questions structure the remaining features of the web portal, both the visible ones such as maps, assessment products, and links to other web-based resources, as well as the invisible ones such as methods coordination and data management procedures. The Monitoring Council has established a basic template for the core assessment questions, modeled after those in the four prototype portals, that focuses on map-based depiction of status and trends at a range of spatial scales, and on the success of efforts to correct or improve problems (Appendix 3, Guidelines for Workgroups and the Development of My Water Quality Theme-Based Internet Portals).

Once established, workgroups are responsible for developing the web portal, creating appropriate guidelines for monitoring and assessment methods and data management procedures, and disseminating these guidelines to local and regional monitoring programs that generate raw data. The Monitoring Council will encourage and/or assist with outreach to additional potential partners and review and comment on draft assessment products and web portal prototypes. The Monitoring Council will also ensure that data management and integration procedures are coordinated as needed across themes, comply with developing State policies, and are compatible with the California Environmental Data Exchange Network (CEDEN) system and its network of regional data centers. Finally, the Monitoring Council will provide technical support as needed. The respective roles of the Monitoring Council and the workgroups are summarized in Table 1.

Table 1. Respective roles of the Monitoring Council and the theme-based workgroups (or other partners) on the six main monitoring program elements defined for the Monitoring Council's efforts in CWQMC (2008) and adapted from USEPA's 2003 report Elements of a State Water Monitoring and Assessment Program (USEPA 2003).

Monitoring program element	Monitoring Council role	Workgroup / partner role
1. Strategy, objectives, design	Collaborate w/workgroup on assessment strategy Ensure compatibility with related themes Comment and review	Define core management questions Develop assessment strategy, detailed monitoring objectives and design(s)

Monitoring program element	Monitoring Council role	Workgroup / partner role
2. Indicators and methods	Set goals for statewide coordination Comment and review	Develop, improve, coordinate indicators and measurement methods Improve coordination statewide
3. Data management	Set basic guidelines, design principles Ensure coordination across themes as needed Provide technical support	Implement data management procedures, user interfaces, applications
4. Consistency of assessment endpoints	Ensure assessment targets questions at statewide scale Set goals for statewide coordination Comment and review	Develop new or apply existing assessment methods Improve coordination statewide, while providing access to a variety of data perspectives
5. Reporting	Define reporting guidelines Set goals for improved efficiency of existing reporting functions Comment and review	Design and produce assessment products Develop reporting functions to support agency reporting requirements
6. Program sustainability	Conduct periodic program evaluations Create and update program plans Obtain needed resources	Implement responses to program evaluations Provide needed input to program planning Predict and highlight resource needs

Within this general framework, the past 18 months' efforts have highlighted the need for flexibility in both working relationships and technical approaches, given the different points from which each effort started, the level of existing coordination, and the specific technical challenges posed by each theme. For example, the Wetlands workgroup included a comprehensive range of stakeholders from its inception, while the Safe to Swim workgroup's membership initially focused only on ocean beaches and the need to satisfy mandates of the federal Beach Act (Beaches Environmental Assessment and Coastal Health Act of 2000, Amendments to the Federal Water Pollution Control Act). Similarly, the Safe to Swim web portal was designed and implemented by State Water Board staff, while the Wetlands web portal was developed by external partners, and the Safe to Eat Fish and Shellfish web portal was a collaborative effort between State Water Board staff and external partners. The Safe to Drink web portal is structured around the State Water Board's GeoTracker GAMA system, which was developed independently to address a separate piece of state legislation (Groundwater Quality Monitoring Act of 2001 (AB 599, Liu)). This portal will soon include data from the Department of Toxic Substances Control's (DTSC) EnviroStor system, which is being expanded to include additional sources of groundwater monitoring data.

While the Monitoring Council's workgroups are organized around a single theme and have a statewide focus, there are programs that operate at the smaller watershed or regional scale, but that nevertheless are potentially useful partners for the Monitoring Council's efforts. These regional scale programs have a wide range of missions and sponsors, ranging from volunteer water quality monitoring to collaborative watershed assessments and large-scale ecosystem

monitoring and restoration programs. The Monitoring Council's organizational structure provides three ways to collaborate with programs focused on the regional scale:

- Supporting coordination of monitoring and data management methods, and disseminating these to regional scale programs, to ensure that key data types are available to and usable by the Monitoring Council's theme-based web portals
- Incorporating specific elements of regional programs into workgroup efforts to develop statewide assessments (e.g., stream bioassessment monitoring, which could be input to the statewide healthy streams subtheme)
- Creating new subthemes to represent integrated assessments of aquatic ecosystem health at the regional scale, especially those with statewide impact (e.g., integrated assessments of the San Francisco Bay-Delta Estuary)

The Monitoring Council is willing to support a range of such relationships, as long as they are compatible with the Monitoring Council's philosophy. Key to any development path, however, is the maintenance of strong relationships with the entities with primary responsibility for conducting statewide assessments for each theme. The Monitoring Council's approach depends on their involvement to assure the accuracy and relevance of all aspects of each web portal and to ensure adequate access to needed data and expertise.

Table 1 and the portal development guidelines (Appendix 3) define core roles and responsibilities for the Monitoring Council, the workgroups, and other partners. However, the past 18 months' experience with the four prototype portals, and preliminary discussions with other theme-based monitoring and assessment efforts, have highlighted the importance of flexibility and adaptability in the early stages of workgroup development and relationship building. As these relationships mature and workgroups gain experience, the Monitoring Council expects that roles and responsibilities will become more formalized over time.

2.2.2 Performance measures

The Monitoring Council adopted a set of performance measures and benchmarks (Table 2) based on USEPA's 2003 report *Elements of a State Water Monitoring and Assessment Program* (USEPA 2003), but condensed USEPA's list of ten elements to six. A description of these six performance measures can be found in CWQMC (2008). Each workgroup will use these measures to evaluate existing water quality monitoring, assessment, and reporting efforts in order to develop specific actions and estimate funding needs necessary to coordinate and enhance those efforts. Appendix 4, *Tenets of a State Wetland and Riparian Monitoring Program (WRAMP)*, produced by the California Wetlands Monitoring Workgroup, illustrates the type of detailed evaluation the Monitoring Council envisions each workgroup will produce. As a key part of such evaluations, workgroups must ensure that monitoring designs and assessment approaches target core management questions. The performance measures provided the structure for a preliminary evaluation of a wide range of monitoring and assessment efforts described in Appendix 3 of CWQMC (2008) and summarized in Table A3.2. of that Appendix.

Table 2. Benchmarks associated with each of the six performance measures used by the Monitoring Council and the theme-based workgroups to evaluate existing web-portals and assessment programs and to track the Monitoring Council's progress toward meeting the goals of each web portal development effort.

Evaluation criteria	Rating benchmarks / performance measures
1. Strategy, objectives, design	Low: No core questions; no, or many undifferentiated, target audiences; poorly articulated or conflicting objectives; uncoordinated monitoring efforts not focused on questions or objectives Medium: Core questions and target audiences implicit in program design; objectives implicit but only partly coordinated and not directly used to structure design effort High: Core questions coordinated, clearly stated, and focused on specific audience(s); clearly stated and common objectives address coordinated core questions and inform all aspects of design
2. Indicators and methods	Low: Indicators and methods uncoordinated, not validated; no QA procedures or plan Medium: Indicators and methods validated but not coordinated statewide; QA procedures exist but are poorly matched to objectives and not coordinated statewide High: Coordinated, scientifically validated, and clearly documented indicators, methods, and QA procedures that match monitoring objectives
3. Data management	Low: No data management procedures or documentation Medium: Data management procedures exist but are not coordinated statewide and only poorly support access to data High: Coordinated and clearly documented data management procedures are coordinated statewide and fully support access to data at multiple levels
4. Consistency of assessment endpoints	Low: No data analysis or assessment procedures used or documented Medium: Data analyzed but methods not coordinated; assessment tools exist but not fully validated or coordinated High: Data analysis methods and assessment tools fully validated, clearly documented, and coordinated statewide, while providing a variety of valid perspectives on the data
5. Reporting	Low: No reporting process or products Medium: Intermittent static reports, available with some effort High: Readily available regular static and dynamic reports focused on core questions and objectives; ability to create user-defined reports at multiple scales and from multiple perspectives
6. Program sustainability	Low: No systematic program evaluation, planning, or long-term funding devoted to infrastructure needs related to coordination and data integration Medium: Intermittent internal program review and planning that may or may not include infrastructure needs; limited funding for infrastructure

Evaluation criteria	Rating benchmarks / performance measures
	High: Regular external program evaluations and planning for all program needs and for statewide integration

2.2.3 A single, global point of entry

A central design feature of the Monitoring Council's approach is that all theme-based web portals, and the water quality data and assessment products they provide, will be accessible through a single, global point of entry. This point of entry has been established at www.CaWaterQuality.net (Figure 3). The Safe to Swim link provides access to a map-based interface and a set of secondary questions (Figure 4). The Aquatic Ecosystem Health theme provides access to a series of subthemes that address a variety of aquatic ecosystem types (Figure 5). Figures 3, 4, and 5 also illustrate the page design the Monitoring Council has established for these higher-level entry points, and with which the theme-specific workgroups must comply (Appendix 3).

The main function of this global point of entry is to solve the long-standing, fundamental data access problem, namely, that it can be confusing and time consuming to find data, assessment products, and background information relevant to a particular question or issue. By providing a direct connection to the individual theme-based web portals, this global entry point will also provide organized access to a broad range of relevant databases and websites maintained by other entities. For example, the Safe to Drink web portal provides a link to the GeoTracker GAMA program website (and soon will also include DTSC's EnviroStor system), the Safe to Swim web portal to Heal the Bay's beach report card website, and the Safe to Eat Fish and Shellfish portal to the fish consumption advisory website of the Office of Environmental Health Hazard Assessment (OEHHA), in addition to a large number of additional state, federal, and non-governmental organization (NGO) websites and databases.

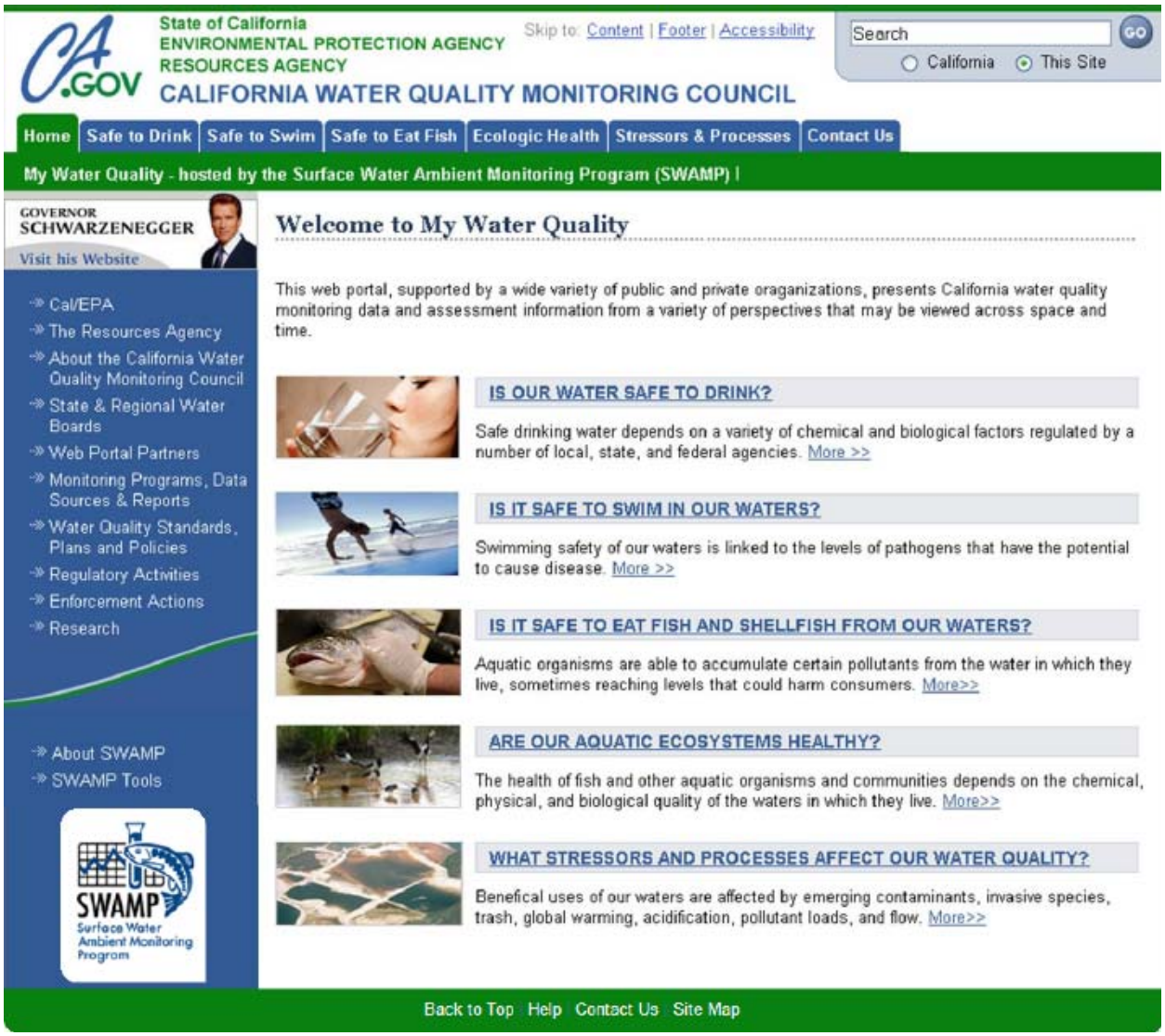


Figure 3. The Monitoring Council's global point of entry to monitoring and assessment information for all theme-based web portals (www.CaWaterQuality.net)

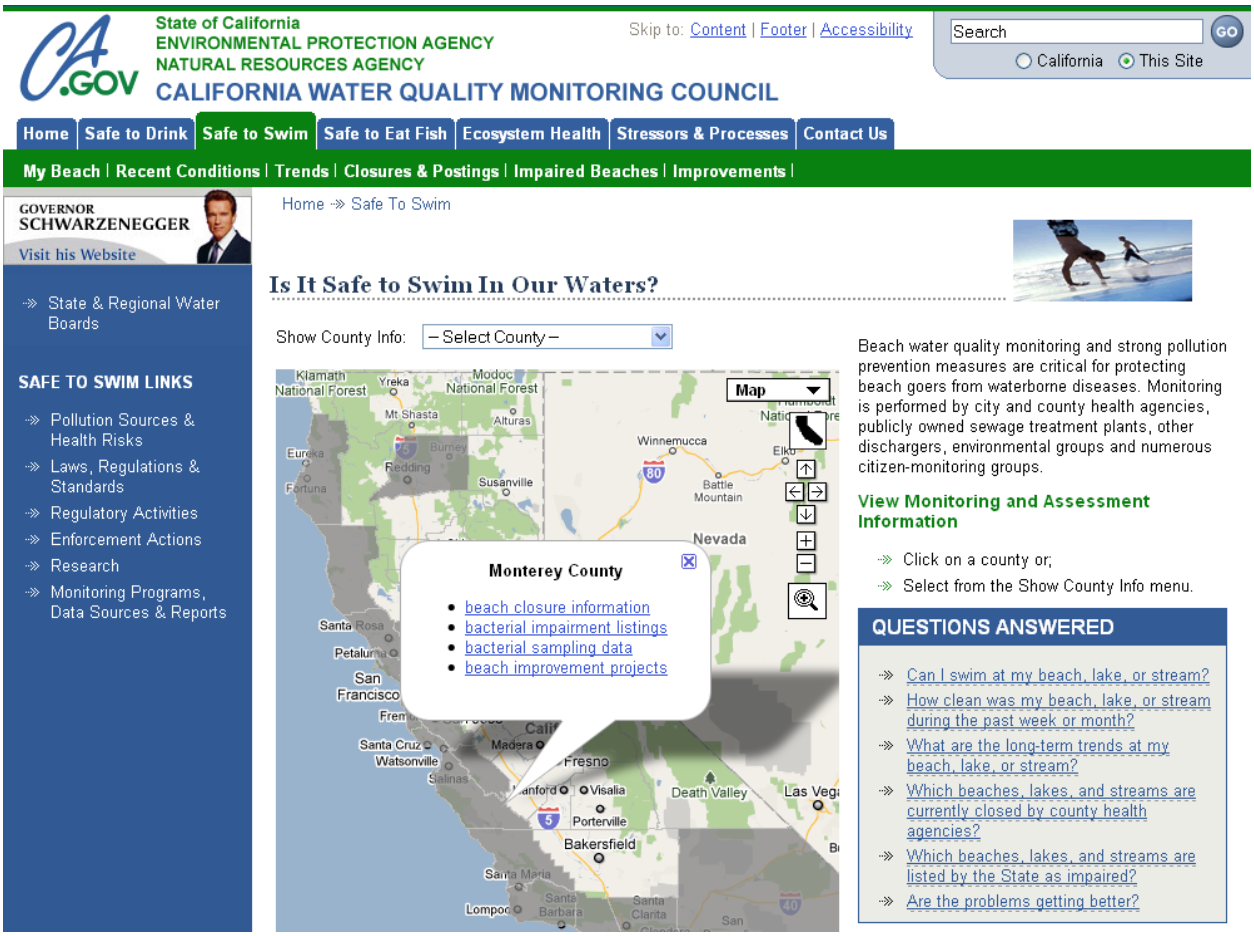


Figure 4. The main Safe to Swim portal page provides a template for the home pages of individual theme or sub-them portals.

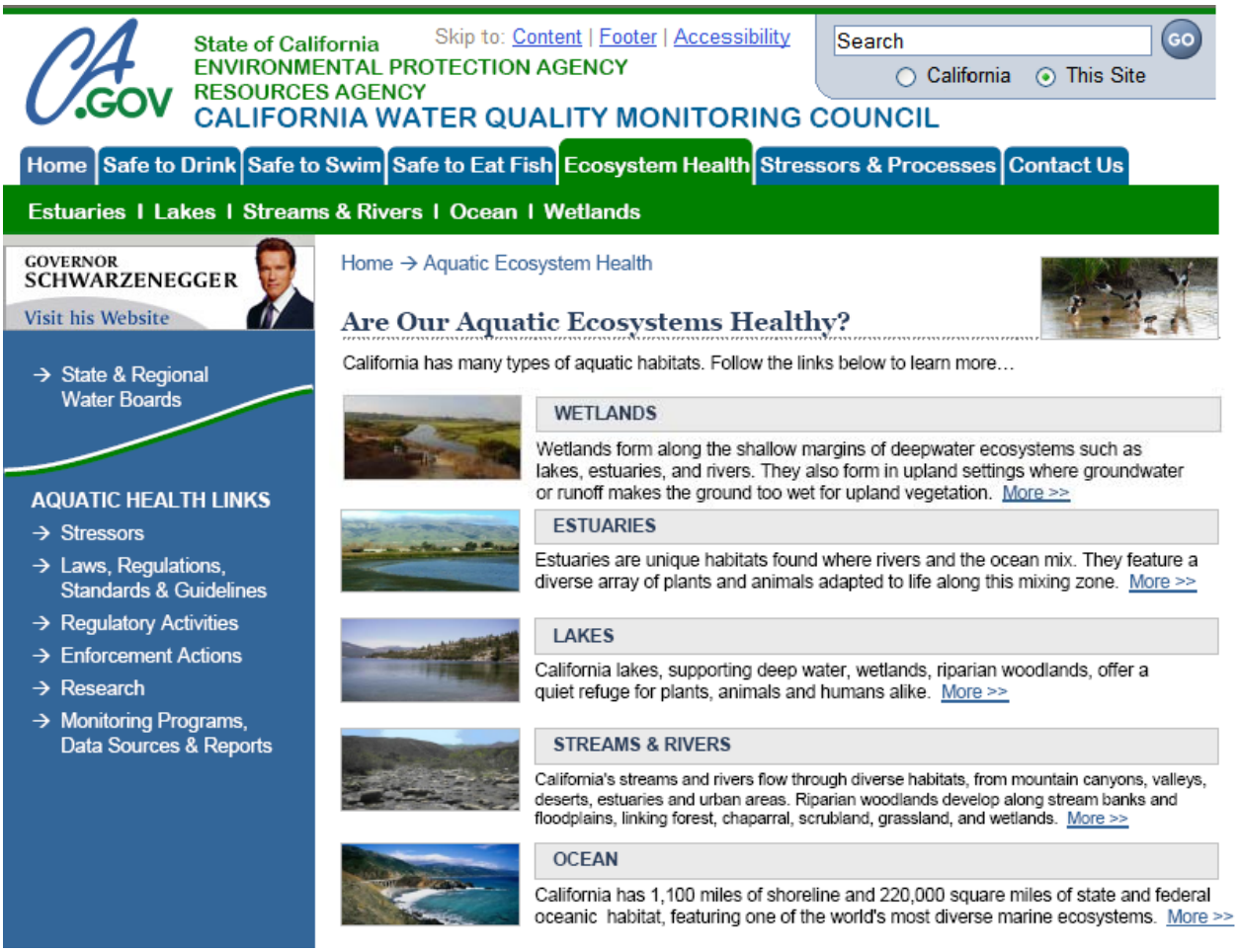


Figure 5. The Aquatic Ecosystem Health web page provides access to a number of separate subtheme portals focused on different categories of aquatic ecosystems.

2.2.4 Coordination of core program elements

Improving the comparability of monitoring program elements is crucial to the successful functioning of the theme-based web portals (see Table 1, especially criteria 1 – 4). Inconsistent monitoring designs and/or methods, indicators, or assessment approaches make it impossible to present credible and reliable assessments at the statewide scale. Thus, making consistent progress toward improved statewide coordination is an important part of the Monitoring Council's workplan (see Chapter 3).

Experience to date with the four prototype portals, as well as experience from past attempts at improving coordination, suggests that the Monitoring Council will encounter a range of situations regarding monitoring designs, indicators, measurement methods, and assessment approaches. As a result, coordination will not follow the same pathway or present the same challenges for each theme, and different sets of guidelines will be applicable for different themes. For example, beach water quality monitoring programs apply the same assessment thresholds, based on AB 411, but have different monitoring design philosophies, with the result that measures of the frequency and magnitude of beach closures have different meanings for different programs. As another example, the wetlands theme faces a situation in which common monitoring methods

have been agreed on, but there is as yet no agreed-on framework for interpreting monitoring results and arriving at consistent conclusions about wetland status.

As explained in CWQMC (2008), not all aspects of all programs require statewide coordination. The Monitoring Council will therefore work with each workgroup to identify program elements that require such larger-scale statewide coordination to support comprehensive assessments and those that can vary regionally to support local needs. Where national or state guidelines already exist, the Monitoring Council will encourage adoption of the highest-level guidelines available. In all cases, however, the Monitoring Council's philosophy (see Sections 1.1 and 2.1) is to present available information in a web portal as soon as some useful statewide information is available, even if it contains data gaps and/or inconsistencies. As explained above, this approach creates the structure and motivation for a transparent process of continual improvement of data, methods, and assessment products (see Figure 2)

2.2.5 Improved data management

The Monitoring Council's approach to improving data access is premised on providing a global point of access to a series of theme-based web portals. These in turn enable access to a wide range of other data sources as needed to fulfill the web portals' analysis, assessment, and reporting functions. This will require comparable data statewide, technical support for infrastructure and tool development, and the ability for users to query and download a variety of data and assessment products.

Work on the prototype web portals to date has demonstrated both the potential for and the challenges of this goal. Fully implementing the set of web portals envisioned will require finding, accessing, and integrating many different data types from a large number of sources, and providing monitoring data and products to users with valid, often wide, differences in needs and perspectives. These challenges are not limited to the Monitoring Council's efforts, and are in fact an important issue for the State as a whole. The Office of the Chief Information Officer recently released its *Statewide Data Strategy Report* (OCIO 2009), which describes the State's approach to overcoming widespread problems related to data access and integration. While it lays out basic principles for the design, functioning, and integration of the State's data management systems, it also allows for needed flexibility as each agency develops its own solutions and strategies. The Monitoring Council's approach is compatible with the State's strategy and is based on two key elements.

The first element involves implementing a distributed data management strategy by establishing locally centralized access and data input points at regional data centers, which are then linked with an exchange network to bring data together as needed. The State Water Board's Surface Water Ambient Monitoring Program has implemented the distributed CEDEN network (Figure 6) which may evolve into the primary source of data to the Monitoring Council's web portals. CEDEN relies on the California Environmental Resources Evaluation System (CERES) metadata catalog and is a distributed enterprise system intended to be flexible enough to accommodate multiple requirements. The CEDEN regional data center nodes fulfill the role of intermediary between larger state systems and small to medium data providers. CEDEN's architecture has been designed to create a long-term solution for delivering complex, scalable, user-friendly applications and information to a wide variety of users.

CEDEN is committed to participating in the USEPA's National Environmental Information Exchange Network (NEIEN) and in implementing their standards for service oriented architecture (SOA) and web services. These frameworks structured the initial design and

implementation of CEDEN, which became operational in 2010. However, the system still requires a substantial amount of development, both of its basic infrastructure and of applications needed to support the theme-based web portals, and this effort is outlined in the workplan in Chapter 3.

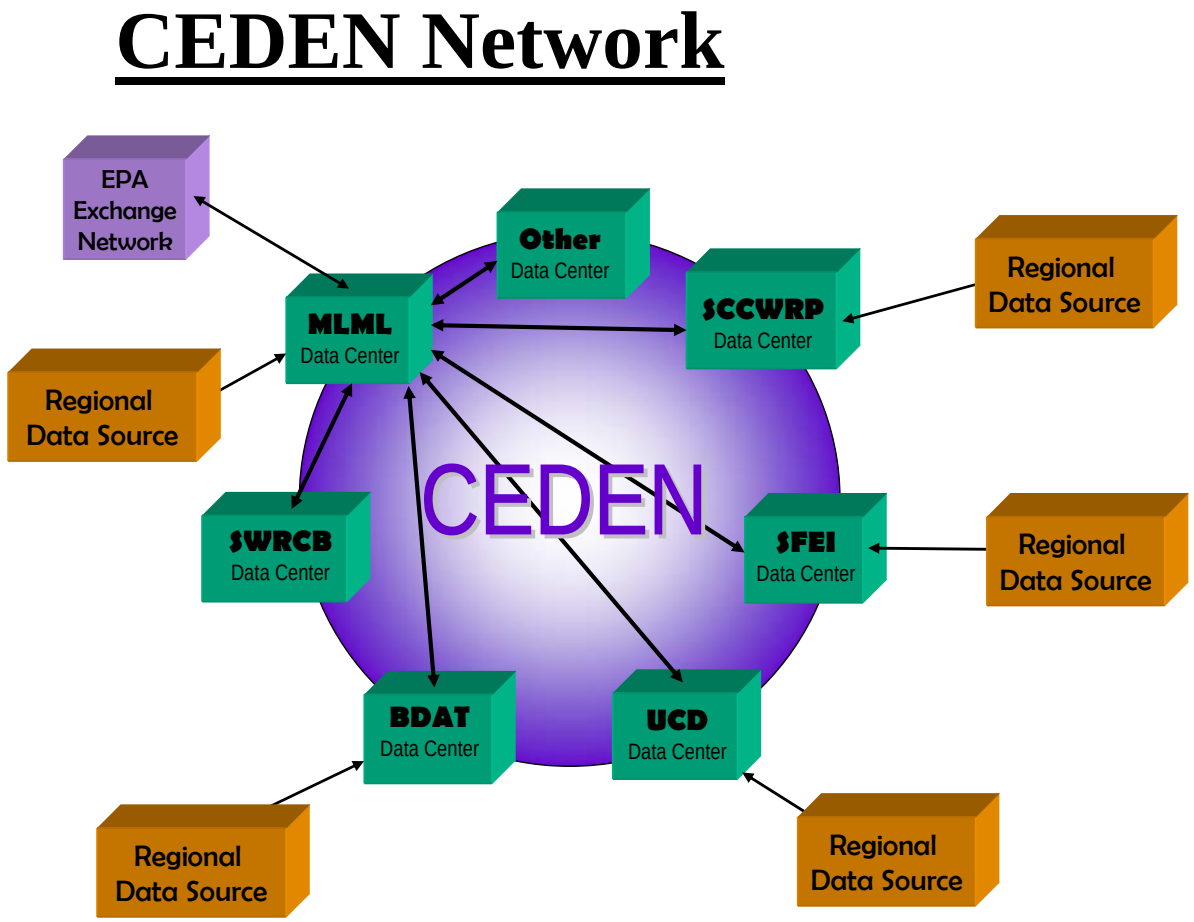


Figure 6. Schematic depiction of the CEDEN network, illustrating the relationships of the regional data centers to each other, to regional data sources, and to the external EPA Exchange Network.

The second element of the Monitoring Council's data management approach is a data management workgroup that will play a critical coordinating role to ensure that the theme-based workgroups:

- Meticulously define their data requirements
- Identify data requirements that cut across multiple themes and that therefore should be coordinated
- Employ data management strategies that comply with appropriate national and state guidelines

- Have a well-established mechanism for communicating data management issues to a body with overall responsibility for oversight and support of individual themes' data management efforts

These functions are illustrated in Figure 7, which shows the Monitoring Council's data management workgroup interacting with the theme-based workgroups at critical points and supporting needed coordination across workgroups.

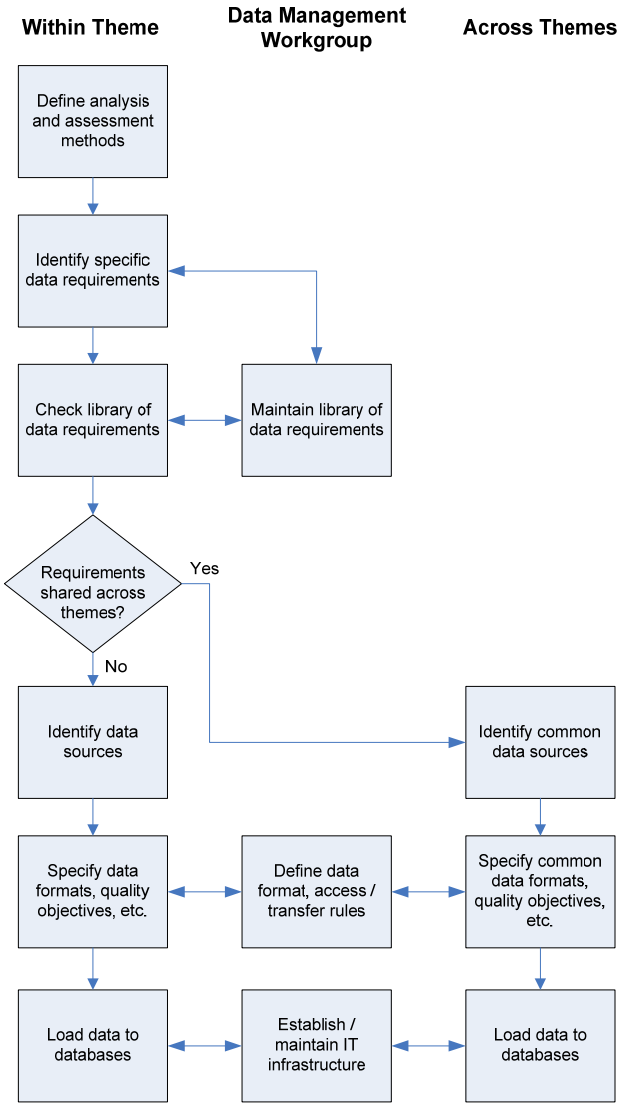


Figure 7. The Monitoring Council's data management workgroup will support data management efforts of each theme-based workgroup, as well as playing a coordinating role where data requirements cut across multiple themes.

In addition to looking inward toward the theme-based workgroups, the Monitoring Council's data management workgroup will look outward to o other partners within and outside of state government to ensure that the Monitoring Council's data management strategy remains aligned with State and federal initiatives and takes advantage of opportunities to utilize useful tools and approaches developed elsewhere.

2.2.6 Monitoring of state financed water quality improvement projects

The State of California provides millions of dollars of funding for water quality and associated ecosystem improvement projects. For a number of reasons, most of these projects do not generate monitoring data sufficient to document the success or failure of these projects. In response, SB 1070 required that the MOU between Cal/EPA and the Natural Resources Agency "shall describe the means by which the monitoring council shall formulate recommendations to … [e]nsure that water quality improvement projects financed by the state provide specific information necessary to track project effectiveness with regard to achieving clean water and healthy ecosystems." The MOU reiterates this mandate in describing the Monitoring Council's responsibilities.

Others have made recommendations to improve monitoring of state financed water quality improvement projects. The Natural Water Quality Committee (NWQC) was formed at the direction of the State Water Resources Control Board to define natural water quality based on a review of monitoring data in Areas of Special Biological Significance (ASBS). Some of their recommendations focused on monitoring of water quality improvement projects funded by Proposition 84 grants. The following is excerpted from the NWQC's *Initial Recommendations for Monitoring ASBS Implementation Projects*.

> After discussions with [State and Regional Water Board] staff, task force members from other grant programs…, and the grantees themselves, the NWQC came to three conclusions regarding the successes and failures of previous grant programs. Frequently in the past, grant programs were incapable of assessing the success/failure of their program for either removal of pollutants or improvements to receiving waters. Inadequate guidance was provided to the grantees on the specific goals of the monitoring programs employed, especially to those grantees that lacked capabilities and experience with monitoring. Specifically, grantees rarely had a vision of the State's monitoring objectives such as cumulative pollutant removal. Even for those grantees with experience and capability, the timeline of the grant programs (typically two to three years) were inconsistent with adequately quantifying the goal of measuring pollutant reductions.
>
> The NWQC discussed several important elements to enhance the Proposition 84 grant program monitoring components. These elements included: 1) a cohesive, question-driven monitoring program; 2) a unified monitoring design that ensures comparability in sampling, data analysis, and information management; and 3) a person or group responsible for coordinating, collating, assessing and reporting on the Proposition 84 monitoring effort. A clear statement of objectives needs to be composed so as to provide a vision for the Proposition 84 monitoring program. Monitoring experts universally agree that this is best achieved through the use of a well-formed and unambiguous monitoring question, much akin to a hypothesis for testing. This question should be crafted with care and agreed to by the Proposition 84 Task Force or other governing body.
>
> A centralized monitoring design should be created with sufficient scientific rigor that the monitoring question can be answered with a specified level of confidence. It is impossible to describe what this design may look like until the monitoring question is created, but there are certain elements that must be included. The first element should be some level of standardized sampling. Standardized sampling approaches ensure representativeness and reduce bias in data collection. For example, flow weighted composite sampling during wet weather runoff can produce very different results than grab sampling, even during the same storm event at the same site. Comparing data from different sampling approaches is inappropriate and could lead to faulty conclusions. Similarly, standardized quality assurance should be achieved through the laboratory analysis portion of a large-scale monitoring program. Comparability is paramount and several large-scale monitoring programs use performance-based quality assurance guidelines to ensure comparability for laboratory analysis. Finally, a centralized data management system is necessary for

> collating the reams of information generated by multiple monitoring programs. Grantees will focus on the monitoring data associated with the management actions specific to their project and these individual data sets will be, for the most part, relatively small and easy to manage. Combining data sets from numerous individual grant projects post hoc, however, would be daunting to impossible and could cost hundreds of thousands of dollars unless a well-conceived information management system is implemented before data collection. Thankfully, several systems exist within the state that could be used as a vehicle for data management.
>
> Finally, a person or group must be tasked from the beginning with the responsibility for coordinating the Proposition 84 ASBS monitoring program. Deriving monitoring questions, ensuring comparability, and quality assurance/training cannot be done as a sideline to one's daily activities. It is a full-time job. The larger the program, the more likely it will require additional personnel to accomplish all of the integration necessary to address the monitoring question. It will be this entity that shall be responsible for communicating with grantees on monitoring and eventually for writing a summary report of the program's success at reducing pollutant loads and/or concentrations.
>
> The NWQC had four recommendations to the ASBS Task Force on a structure for the statewide grant monitoring program to achieve the three goals of monitoring question(s), comparability, and organization. The first recommendation stated the singular monitoring question of utmost importance, "How much pollutant (i.e., in kg) was removed as a result of the grant-funded BMP?" Several additional questions are feasible and perhaps warranted, but this single question must be answered. The second recommendation addressed who should coordinate the Proposition 84 monitoring. The NWQC felt that the [State Water Board] should coordinate this monitoring, perhaps through one of their statewide programs such as the Surface Water Ambient Monitoring Program (SWAMP). Third, the NWQC felt that at least 10% of each grant should be allocated to monitoring activities. Each grantee can conduct this coordinated monitoring themselves or, if they prefer, return 10% of the grant back to the [State Water Board] to arrange for the coordinator to conduct this monitoring. Regardless of who implements the monitoring, the [State Water Board] must use the $1 million set aside from Proposition 84 to conduct the coordination, quality assurance, and data management to ensure comparability. Finally, the NWQC recommended that grantees be allowed a 1-year, no-cost extension to conduct post-construction monitoring. The extra time will provide invaluable monitoring information, particularly in the drier parts of the state where rainfall is limited to a short window of time during the year.

The Monitoring Council believes that these recommendations for monitoring Proposition 84 grant projects provide a sound basis to improve the effectiveness of most monitoring for other state funded water quality and ecosystem improvement projects. The ability of the state to verify the success of these projects and the ability to utilize grant project monitoring results in larger scale assessments depends on reforms such as those outlined above. However, due to contracting problems that currently limits SWAMP and other state agencies (see Section 3.3.3. *Contracting and implementation constraints*, below), it may be better for an existing or new joint powers authority or university to provide monitoring coordination.

There are categories of state funded water quality and ecosystem improvement projects that fall within the purview of existing and future Monitoring Council workgroups. For example, the Clean Beaches Initiative (CBI) grant projects funded by the Water Boards are included in the Safe to Swim portal and the coordination efforts of the Beach Water Quality Workgroups. In such cases, the theme-based workgroups would also be appropriate bodies to provide direction and coordination on effectiveness monitoring.

To better plan improvements to monitoring associated with state funded improvement projects, an estimate of the amount of grant dollars spent on monitoring needs to be developed.

Chapter 3: The Monitoring Council's Ten-Year Workplan

The Monitoring Council has developed a ten-year workplan (Workplan) to implement the approach described in Chapter 2. The Workplan is divided into three phases, with different technical and management challenges and levels of effort allocated to each:

- Start-up: Years 1 – 2
- Development: Years 2 – 8 (overlapping with Start-up)
- Long-term maintenance: Years 9 – 10 (and beyond)

The Workplan includes two complementary and parallel types of effort (Figure 8) essential to accomplishing the five-part solution described in Section 2.2. The left-hand side of Figure 8 represents effort carried out at the level of the individual theme-based workgroups. This effort would in general follow the approach developed to date for the four prototype themes, applying lessons learned during those initial efforts. The right-hand side of Figure 8 represents tasks that are the direct responsibility of the Monitoring Council because they relate to establishing and maintaining the program's technical, management, and financial infrastructure.

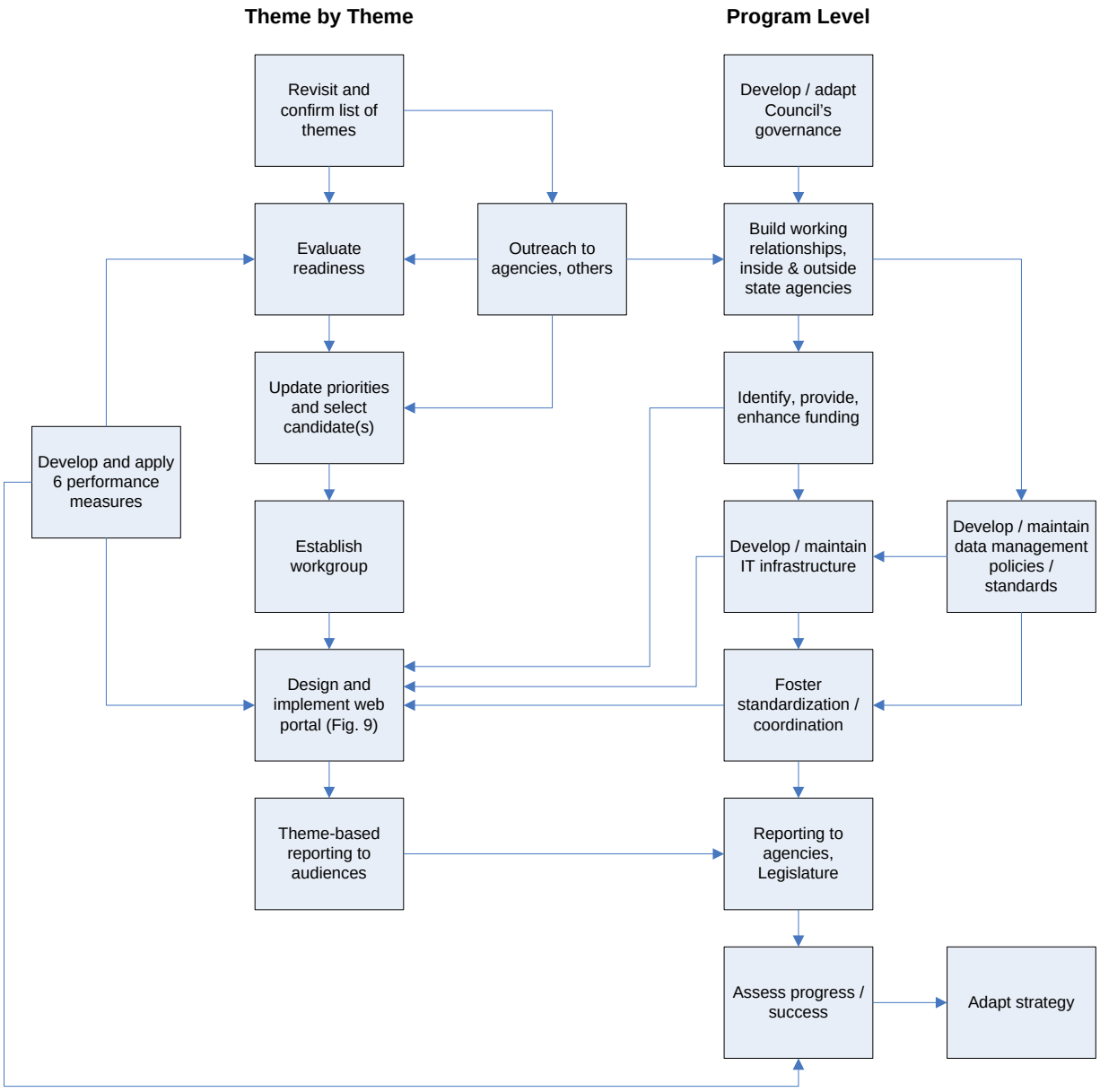


Figure 8. Parallel tracks needed to implement theme-based monitoring and assessment within the context of web portals. The Comprehensive Monitoring Program Strategy focuses primarily on the right-hand side of the figure.

3.1 Theme-by-theme tasks

Specific tasks required to prioritize themes for action, establish workgroups, and develop a series of individual web portals are shown on the left-hand side of Figure 8. The following discussion follows the figure from top to bottom.

3.1.1 Prioritize targets for development

The list of potential themes (see Table 3) will be periodically revisited to determine if adjustments are required. For example, the Monitoring Council recently reorganized the Aquatic

Ecosystem Health theme (Figure 5) to streamline the development of web portals for the associated subthemes. The Monitoring Council will assess the readiness of each theme by evaluating its performance on each of the six performance measures (see Section 2.2.1, and Appendix 3 of CWQMC 2008).

The Monitoring Council will then prioritize themes for development, using a prioritization scheme based on the following three criteria:

- Level of concern to the public and managers
- Level of effort involved (based on each theme's score on the six performance measures, as illustrated in detail in Appendix 3 of CWQMC (2008))
- Near-term opportunities (i.e., low-hanging fruit) involving interested monitoring / assessment programs, immediate sources of funding, or situations that demonstrate technical methods or institutional arrangements that further the goals of the Statute

This recent prioritization indicates that streams and rivers, rocky intertidal, kelp beds, and estuaries are the immediate highest priorities for the next set of web portals or portal sections. Each of these is currently being addressed by monitoring programs that provide ready opportunities for productive partnerships with the Monitoring Council. The Healthy Streams Partnership being developed by the State Water Board's Surface Water Ambient Monitoring Program (SWAMP) encompasses the former Perennial Streams Assessment (PSA) which focuses on bioassessment and physical habitat primarily in perennial wadeable streams, Stream Pollution Trends (SPoT) which monitors at the bottom of watersheds including rivers, and efforts to develop biological objectives for these habitats.

The California Ocean Protection Council provides coordination and guidance on ocean ecosystem monitoring, assessment, and protection efforts throughout California. At their September meeting, Monitoring Council Member Linda Sheehan recommended that the OPC take on the responsibility of developing a California ocean health workgroup and Internet portal. Within the ocean health theme, the Multi-Agency Rocky Intertidal Network (MARINe) is a statewide intertidal monitoring program sponsored by a consortium of federal, state, and nonprofit partners. Regional surveys of kelp bed extent in the Southern California Bight are sponsored by a group of local permittees and Regional Water Boards with the goal of tracking and explaining patterns and trends in kelp bed extent.

The Interagency Ecological Program, the San Francisco Bay Regional Monitoring Program, and the developing Delta Regional Monitoring Program are currently coordinating various monitoring efforts within the San Francisco Bay-Delta Estuary. Bringing together these three efforts could form the nucleus of a California Estuaries Workgroup and Internet portal, initially focusing on the largest and most important of California's estuaries. Considering that the Delta is the source of water supply for much of California, the declining status of the Bay-Delta ecosystem has risen to the level of statewide importance.

The Monitoring Council's emphasis on periodic prioritization recognizes the fact that all themes and subthemes cannot be addressed immediately. Implementation must therefore optimize the effectiveness of available resources, address first those issues of most concern to managers and the public, take advantage of existing infrastructure, and build momentum and support for the overall concept of expanding the use of theme-based web portals. Table 3 illustrates how the Monitoring Council has applied the three prioritization criteria. The safety of drinking water received the highest level of concern, with fish and shellfish consumption safety and swimming

safety the next priority. In general, the status of aquatic life is a lower priority, with exceptions at certain times and places for some audiences, for example the decline of the San Francisco Bay-Delta estuary ecosystem and the role of water diversions, pollution, and invasive species in that decline. The level of effort needed to meet the goals of the Statute for each portal is rated on four-point scale, based on each theme's scores on the performance measures. High scores correlate with a lower level of effort required. Themes that have expressed an interest in participating in the Monitoring Council's activities, have access to independent sources of funding, and/or have an institutional infrastructure to promote coordination and access are rated as the best opportunities.

Table 3. Summary results of the prioritization exercise. For each criterion, lower numbers represent a higher priority. The overall priority is the simple average of the individual ratings on three separate criteria. Web portals have been developed for themes and subthemes shown in ***bold****. Themes shown in* ***shaded bold*** *type represent the next set targeted for portal development.*

	Prioritization Criteria			
Theme-based portals *(in italics)* and sub-themes	Level of concern	Level of effort	Opportunity	Overall priority
Is our water safe to drink?				
Surface water	1	1	3	1.7
Groundwater	1	2	1	1.3
Water at the tap	1	3	2	2.0
Is it safe to eat fish and shellfish from our waters?				
Sportfish	2	2	1	1.7
Shellfish	2	1	2	1.7
Is it safe to swim in our waters?				
Freshwater	2	4	3	3.0
Beaches, bays, and estuaries	2	1	1	1.3
Are our aquatic ecosystems healthy?				
Estuaries	3	2	2	2.3
Lakes	3	4	3	3.3
Streams and Rivers				
Wadeable streams	2	1	1	1.3
Rivers	3	3	3	3.0
Freshwater fish	3	4	3	3.3
Ocean				
Shallow marine reefs	3	1	2	2.0
Rocky intertidal	3	1	1	1.7
Kelp beds	1	1	1	1.0
Subtidal benthos	3	1	2	2.0
Marine fish	3	3	3	3.0
Wetlands	3	2	1	2.0
What stressors and processes affect our water quality?				
Loadings (include trash/ocean debris)	3	4	4	3.7
Flows	3	1	4	2.7
Levels of contamination				

	Prioritization Criteria			
Theme-based portals *(in italics)* and sub-themes	Level of concern	Level of effort	Opportunity	Overall priority
Water				
Freshwater	3	4	4	3.7
Marine	3	2	4	3.0
Sediment				
Freshwater	3	4	4	3.7
Marine	3	2	3	2.7
Aquatic life				
Freshwater	3	4	4	3.7
Marine	3	3	2	2.7
Fisheries				
Anadromous fish	2	2	2	2.0
Invasive species	3	2	3	2.7
Endangered species				
Harmful algal blooms	3	1	1	1.7
Landscape maps	3	3	2	2.7
Measures of climate change	2	1	3	2.0
Ocean acidification	2	4	3	3.0

3.1.2 Establish and task workgroups

The Monitoring Council will then establish workgroups for each of the high priority themes and subthemes. While there is a division of responsibility between the Monitoring Council and the workgroup (Table 1), there is no set formula for how workgroups are established and their members selected. In general, the Monitoring Council anticipates the circumstances shown in Table 4, illustrated with the four prototype web portals addressed in 2009 and the themes identified for 2010.

Table 4. Possible circumstances the Monitoring Council will face in establishing workgroups to address web portal development for each theme and subtheme. Prototype themes addressed during 2009 and additional themes scheduled for 2010 are placed in the framework as illustrations.

	Lead responsibility clear	Responsibility split
Workgroup exists and complete	Rivers and Wadeable Streams	Wetlands Rocky intertidal
Workgroup exists but incomplete	Safe to Eat Fish and Shellfish Safe to Swim Safe to Drink Ocean Ecosystem Health	~~Kelpbeds~~ Estuary Ecosystem Health
No workgroup		

Depending on the circumstance, the Monitoring Council could simply adopt an existing workgroup, as it did with the Wetlands and Safe to Eat Fish and Shellfish workgroups, or adopt

an existing workgroup and, as work proceeds, reorganize and/or expand the workgroup to include the needed range of expertise and perspectives. For example, the Monitoring Council has recommended reorganizing the Safe to Swim workgroup to foster a statewide perspective and will encourage expansion of both the Safe to Swim and Safe to Drink workgroups to capture, respectively, the perspectives of inland monitoring programs and users of the information provided by the web portal. Where no workgroup currently exists, the Monitoring Council will establish one based on discussions with stakeholders both within and outside of State agencies.

The Monitoring Council will meet with representatives of each workgroup to develop a written charge or workplan for the workgroup (see Appendix 3). Existing web portals will provide examples of the structure, functionality, and look and feel required, and the Monitoring Council at this stage will also clarify data management and data integration guidelines. Most importantly, the Monitoring Council will either define the core management questions around which the web portal will be constructed, or review and approve questions developed by the workgroups. At the moment, the Monitoring Council and its workgroups are operating on the basis of “handshake” agreements. While these have sufficed for the four prototypes, a more formal relationship will be needed as the number and variety of workgroups increases (see Section 3.3.1).

3.1.3 Design and implement web portal

Working from its charge, the workgroup will design and implement the theme-based web portal. The process (Figure 9) will follow that used to date to develop the four prototypes, with the addition of more formal procedures for identifying data gaps, applying State and Monitoring Council guidelines, and feeding adjustments back to monitoring programs to improve their coordination and their ability to support statewide assessments. This process locates detailed design responsibility at the workgroup level, while providing for input and review by the Monitoring Council at appropriate points in the process (see also Table 1). Implementing this process will require additional staff support for the Monitoring Council.

The process illustrated in Figure 9 places the definition of core management questions and assessment products at the front end of the web portal design process. This reflects the Monitoring Council’s fundamental philosophy that the web portals will be effective only to the extent that they are question driven and that statewide assessments are targeted directly at answering users’ questions.

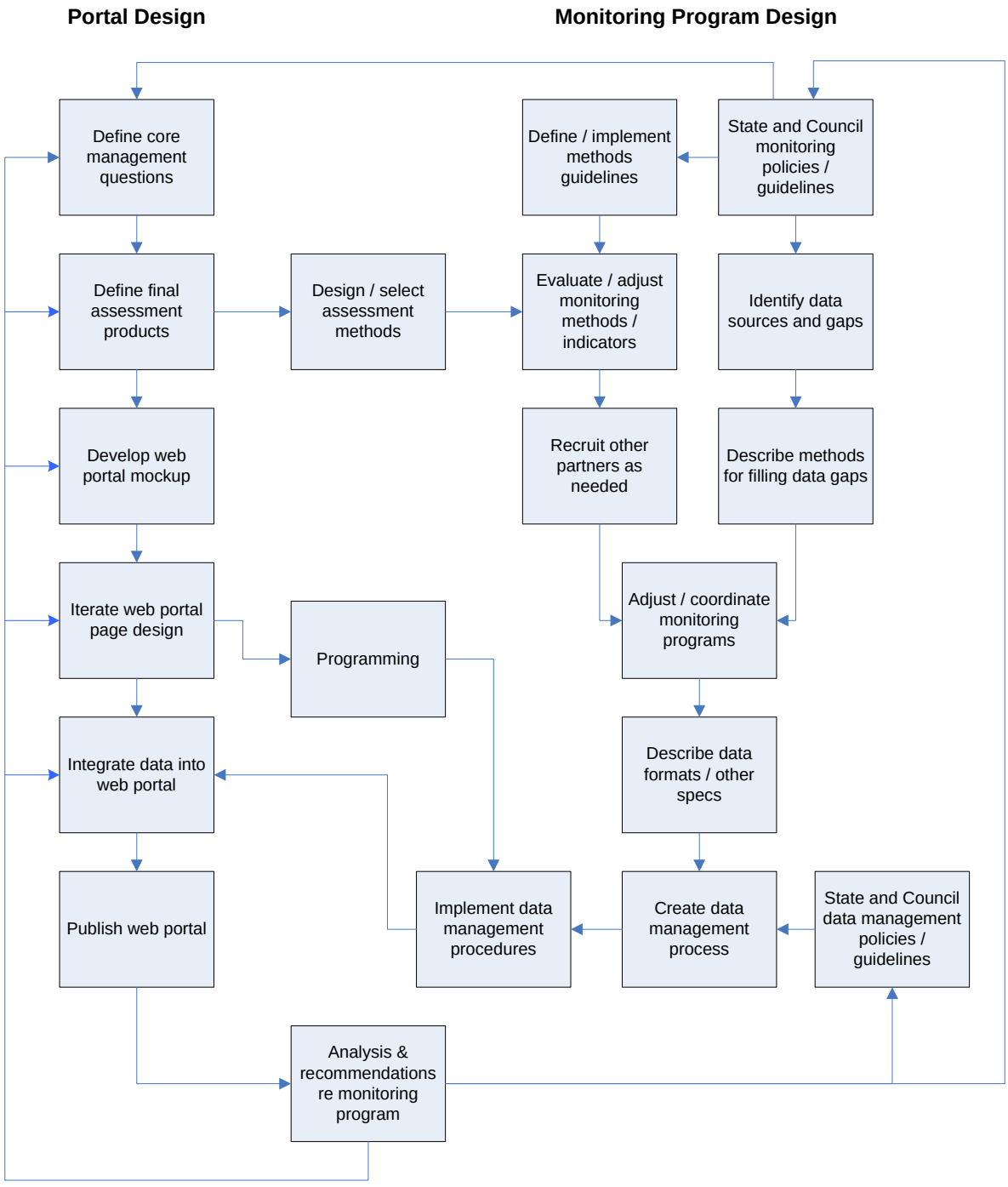


Figure 9. The process for designing and implementing individual theme-based web portals.

3.2 Program-level workplan schedule

Tasks required to develop and implement the Monitoring Council's programmatic infrastructure are shown on the right-hand side of Figure 8 and are the core responsibilities of the Monitoring Council itself. The effort involved in carrying out these tasks, and supporting the theme-by-

theme tasks shown on the left-hand side of Figure 8, can be split into three developmental phases:

- Start-up: Years 1 – 2
- Development: Years 2 – 8 (overlapping with Start-up)
- Long-term maintenance: Years 9 – 10 (and beyond)

All tasks shown in Figures 8 and 9, and discussed in Section 3.1, are relevant to each developmental phase. However, the specific technical and management challenges will differ from phase to phase, as will the staffing, cost structure, and level of effort needed to accomplish each task. The following sections briefly describe the tasks specific to each phase of the Workplan. Tasks are discussed in terms of the five-part solution described above (Section 2.2):

- Organizational structure with common policies and guidelines
- Performance measures applicable to all themes and web portals
- A single, global point of entry
- Coordination of monitoring and assessment methods that achieves an appropriate balance between statewide consistency and regional flexibility
- Database and data management guidelines necessary for more efficient data access and integration

3.2.1 Start-up: Years 1 – 2

The start-up phase encompasses 2009 and 2010 and continues and expands the foundation building efforts begun in 2009, targeting a series of specific milestones. Work during this phase focuses primarily on completing the development of policies and procedures, solidifying relationships with key partners, and expanding initial web-portal development efforts.

Organizational structure: The Monitoring Council will continue to develop its governance structure and formalize it as needed. Written procedures will be established for recruiting replacement members and for deciding whether and how the Monitoring Council's size and makeup could be adjusted. The respective roles of the Monitoring Council and its workgroups will be described in more detail and a format for a written agreement developed. The Monitoring Council will also further examine the three types of authority described in CWQMC (2008) for ensuring recommendations, especially regarding coordination, are implemented, i.e., voluntary adoption, permit/grant/contract requirements, and legislation. In addition, the Monitoring Council may enter into a variety of cooperative agreements with agencies and other sponsors of monitoring programs. These mechanisms will be described more completely and procedures investigated for implementing them in different situations.

The Monitoring Council will continue its structured outreach to potential partners in State and federal government, local and regional agencies, and non-governmental and volunteer entities. Outreach will be targeted primarily at entities directly involved in monitoring and assessment related to the highest priority themes and subthemes. However, the Monitoring Council will also respond to spontaneous overtures from other potential partners to investigate whether these may provide unexpected opportunities to achieve progress toward the Monitoring Council's objectives. Further developing relationships with upper-level management in key partner agencies and departments will be a high priority, as will developing a closer working relationship with managers involved in developing the State's data management policies.

The Monitoring Council will assess the workload associated with the developing program described here and determine the staffing requirements needed to support this effort. This will contribute to budget change proposals for staff and contract resources.

Performance measures: The Monitoring Council will develop more detailed descriptions of the six performance measures (Table 2) and a systematic method for applying them to a wide range of web portals and the monitoring and assessment programs on which they are based. It will be important to improve the consistency of the performance measures and to determine whether the existing qualitative scoring system is adequate. The Monitoring Council will develop a plan for applying the performance measures to its web portals on a regular schedule in order to assess progress and highlight specific areas for improvement. The plan will include a means of reporting results to the program's staff, partners, and audiences.

Single, global point of entry: The Monitoring Council will maintain its main My Water Quality web site, complete the initial phase of development for the first four prototype portals, identify and begin needed enhancements to the prototype portals, and begin development of the next set of web portals. This will involve establishing and tasking workgroups, developing core management questions, and embarking on the other tasks described in Section 3.1 and Figure 9.

Coordination: Based on its experience with the four prototype portals, the Monitoring Council will develop a more detailed approach to coordination of those aspects of monitoring programs needed to support statewide assessments of the core management questions for each web portal. This will involve developing procedures to assist workgroups in using the performance measures to identify data gaps and methods inconsistencies that undermine the breadth and comparability of monitoring data and assessment results. It will also require the Monitoring Council to develop procedures for resolving these issues and tracking workgroups' progress toward such resolution. At another level, the Monitoring Council will identify other sources of inconsistency that cut across individual web portals and that will require more direct involvement by the Monitoring Council to address.

Data management: The Monitoring Council will stay abreast of the State's developing data management policies and ensure adequate channels of communication are in place. The Monitoring Council will also use development of the prototype web portals to identify data management issues that must be resolved at a higher level, implement the initial phase of CEDEN, and identify policies and procedures needed to ensure that data management methods and the reporting web portals are both compatible with CEDEN and make effective use of its capabilities. In particular, the Monitoring Council will establish a data management workgroup with appropriate representation to achieve the goals outlined in Section 2.2.5. As with the theme-based workgroups, the data management workgroup will operate under a charge established by the Monitoring Council.

3.2.2 Development: Years 2 –8

The development phase will encompass 2010 to 2016 and will focus on fully implementing the policies and procedures defined in the Start-up phase, revising them as experience dictates, and moving into the routine development and publication of the series of theme-based web portals. An important function for the Monitoring Council during this phase will be to identify funding sources and obtain needed funding.

Organizational structure: The Monitoring Council will fully implement all policies and procedures developed during the Start-up phase, including establishing more formal working arrangements with the theme-based workgroups, conducting routine outreach and relationship building/maintenance with existing and potential partners, and formalizing mechanisms for ensuring that standardization policies are fully implemented and complied with.

Performance measures: The Monitoring Council will implement regular assessments of its web portals and report the results to program staff, partners, and audiences. In addition, the Monitoring Council will routinely apply the performance measures to high priority themes and subthemes as they are being considered for development, in order to produce more detailed and accurate estimates of effort required for web portal development.

Single, global point of entry: The Monitoring Council will stabilize the design of its My Water Quality main portal entry website and complete the full implementation of all features intended to support data access, analysis, visualization, downloading, and other assessment applications. The second set of web portals will be completed and a series of workgroups established to continue the regular production, maintenance, and enhancement of additional web portals.

Coordination: The Monitoring Council will make the use of the performance measures to identify inconsistencies at the level of individual themes and web portals a standard workgroup practice, and will support, encourage, and require workgroups to resolve inconsistencies and will track each workgroup's progress toward needed coordination. The Monitoring Council will also work with its partners to develop more global monitoring guidelines that cut across multiple themes and will publish these standards to all workgroups and incorporate them into the performance measures.

Data management: The Monitoring Council will complete the implementation of CEDEN, including the regional data centers and will publish documentation, policies, and procedures necessary for maintaining the system. The Monitoring Council will also ensure that the data management workgroup stays abreast of new directions in the State's data management policies, as well as of evolving monitoring requirements and users' needs that call for new system capabilities.

3.2.3 Long-term maintenance: Years 9 – 10 (and beyond)

The long-term maintenance phase will extend from 2017 forward and will focus on maintaining and adapting the policies, procedures, funding, and the technical infrastructure needed to ensure the web portals and theme-based workgroups remain both operational and relevant. This will involve periodically reevaluating all aspects of the Monitoring Council's five-part solution to assess their continued relevance and performance.

3.3 Budget

Accomplishing the goals and activities outlined in Sections 3.1 and 3.2 will require funding at both the Monitoring Council and the theme-based workgroup levels, that is, for both the left- and right-hand sides of Figure 8. The Monitoring Council's funding strategy is based on its experience with the four prototype portals as well as experience gained by other monitoring and assessment programs that have promoted coordination at regional and statewide scales.

3.3.1. Funding strategy

The Monitoring Council assumes that the bulk of funding for work on individual themes and subthemes (the left-hand side of Figure 8) will come from the participating entities. This bottom-up support will involve varying combinations of ongoing monitoring efforts, in-kind support, outside grants, offsets to existing monitoring requirements, and savings over time from improved coordination and efficiency. Funding for Monitoring Council activities represented on the right-hand side of Figure 8, namely coordinating across themes, developing and maintaining infrastructure, and catalyzing start-up efforts, could come from the budgets of Cal/EPA and the Natural Resources Agency, contributions or grants from other agencies, a portion of monitoring funds allocated to meet grant or regulatory requirements, and/or new fee structures intended to directly support the Council's activities. An important aspect of the Monitoring Council's role will be to ensure that theme-based workgroups identify and achieve the cost savings possible through increased coordination, efficiency, and access to data.

Elements of this funding strategy have been successfully implemented in many instances throughout the state. At the watershed scale, regional monitoring and assessment programs in the San Gabriel River and Los Angeles River watersheds have been funded by in-kind staff support and by resources made available through achieving efficiencies in existing compliance monitoring programs. At a larger scale, the Southern California Bight Program funds its periodic (once every four years), large-scale monitoring through a combination of compliance monitoring offsets, direct funding by participants, in-kind staff support, and core funding to the Southern California Coastal Water Research Project (SCCWRP). In northern California, the Regional Monitoring Program (RMP) in San Francisco Bay is funded by direct contributions from a wide range of participants. In all four of these examples, regulatory compliance monitoring was reduced and the resources redirected to strengthen regional monitoring efforts. At the statewide level, the four prototype portals illustrate the feasibility of this strategy by combining program-specific funding from a variety of sources with the State Water Board's direct support of the Monitoring Council's activities.

The Monitoring Council believes that several important factors will motivate participation in and support for the theme-based workgroups and portal design efforts. First, there is visible and growing interest at the highest levels of state and federal agencies in expanded regional and statewide monitoring and assessment. This will provide a rationale and direction for coordinating efforts across programs and agencies. As just one example, the U.S. Fish and Wildlife Service recently initiated a Landscape Conservation Cooperative (LLC) for California that encompasses much of the state with the goal of identifying, mapping, assessing, and conserving a number of key habitat types.

Second, many of the core questions that structure the portals respond directly to regulatory and resource management drivers. Data and assessments that are better coordinated and of higher quality, and that are produced more efficiently, will therefore be valuable to local permittees, management agencies, and public interest groups. For example, the Monitoring Council's Safe to Swim portal was quickly adopted by the Beach Water Quality Workgroups in southern California and the Central/Northern California Ocean and Bay Water Quality Monitoring Group, made up of local health departments, permittees and management agencies. Once the portal's initial design was completed, Heal the Bay, a public interest group, quickly agreed to make its beach report card website accessible through the Monitoring Council's portal. Because they will provide ready access to data and assessments that are coordinated at larger scales, the web portals will also prove useful to planning efforts such as those required for updating municipalities' general plans, thereby expanding the audience for monitoring results. The

portals, and the integrated data and assessment tools they are intended to provide, will also dramatically improve the accuracy and efficiency of the State's integrated (303d/305b) reporting process.

Third, the Monitoring Council's approach to portal development provides an opportunity for monitoring programs to increase their efficiency, broaden the accessibility and utility of their data, and contribute to broader and more complex assessments and synthesis through improved coordination. The Monitoring Council's experience with the four prototype portals and the positive response it received from representatives involved in the next set of themes (i.e., rivers and streams, rocky intertidal, estuaries, ocean waters) validate the strength of this motivation.

3.3.2. Estimated budgets

As previously mentioned, the overall budget needed to accomplish the Monitoring Council's recommended Comprehensive Monitoring Program Strategy will include two main elements: funding for the Monitoring Council's coordinating role and funding for efforts of the individual theme-based workgroups, with this latter element generated primarily by the entities participating in each theme-based workgroup.

Based on experience with the four prototype portals and SWAMP's experience developing CEDEN, the Monitoring Council's core coordinating role will require:

- Four fulltime State Water Board staff for the first four years of the program, with two devoted to outreach and workgroup coordination and two devoted to directly assisting in developing software for portals and integrating them into an overall data management system; a fifth staff person to be added in Year 5 to assist with workgroup coordination
- $50,000 per year per workgroup for direct support of ongoing workgroup efforts at monitoring coordination, development of improved assessment tools, and implementation of enhanced data management capabilities
- $10 million over ten years for information technology infrastructure

The second main funding element is related to efforts of the theme-based workgroups. Their number (up to 30, organized into the five main categories shown in Figure 5), diversity, and differing degrees of development make it difficult to accurately estimate the cost for accomplishing the Monitoring Council's strategic goals for each theme and subtheme. However, the Monitoring Council does have recent experience with two examples that bracket the likely range of effort involved in establishing portals and ensuring that monitoring and assessment programs meet the performance measures described in Section 2.2.2. Developing the Safe to Swim portal for ocean beaches required a relatively low level of effort by the Monitoring Council that involved building the portal itself, linking to existing datasets and assessment tools, and completing some minor reprogramming of data paths. The cost for this initial effort amounted to approximately $50,000divided roughly 1/3 and 2/3, respectively, between portal conceptualization and GIS/web development. As explained in section 1.1 above, the Safe to Swim portal development effort highlighted the need for an improved data management system to allow data to flow more easily among those conducting the monitoring, state and federal regulatory agencies, and the portal. The new system will provide more real-time information access via the portal and is projected to cost an additional $50,000 to develop. While incorporating data from inland swimming sites and improving data management and assessment tools will require additional effort, the $90,000 expended to date is probably

representative of the level of effort needed to create a portal for a theme or subtheme with an existing statewide data management infrastructure and functioning assessment tools.

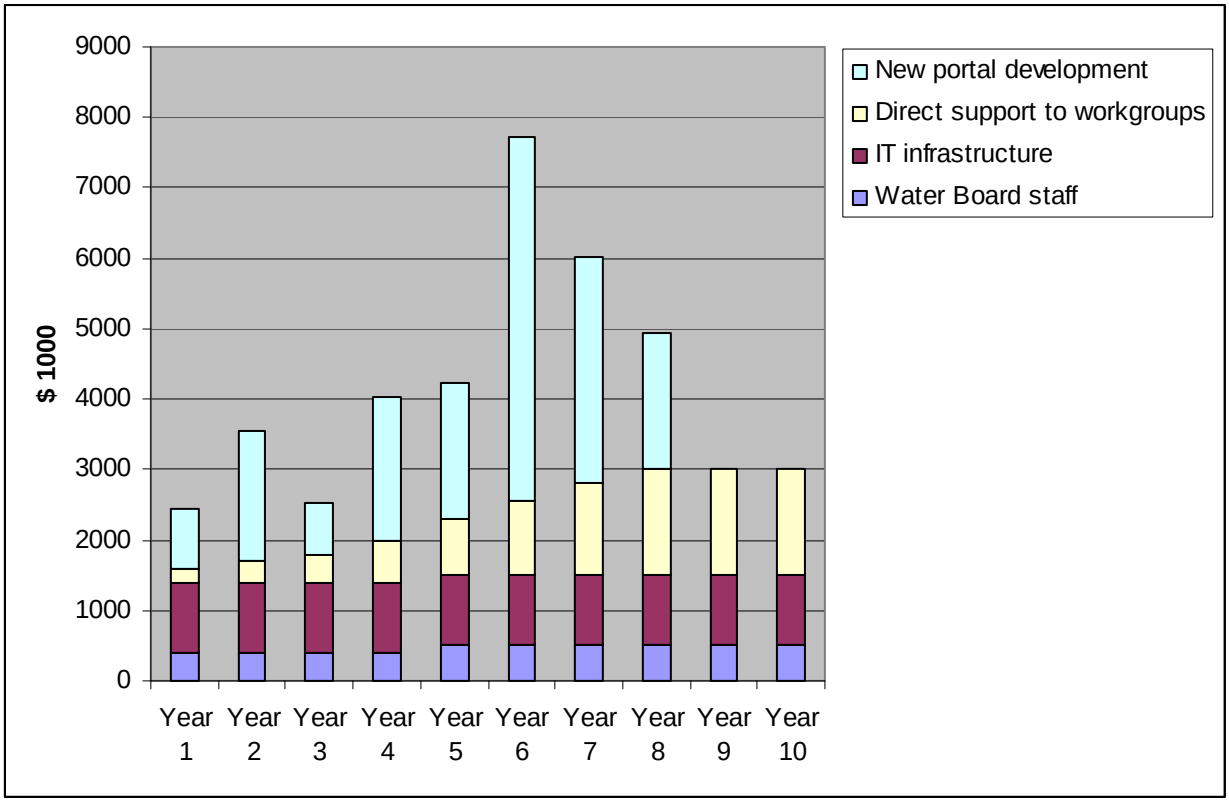
At the other extreme, the Wetlands workgroup has identified (Appendix 4) a substantial amount of effort needed to implement coordinated monitoring and assessment protocols and to conduct the baseline mapping required for statewide assessment. The workgroup has estimated one-time startup costs related to portal development at $1.2 million (Table 1, Appendix 4).

The Monitoring Council has generated a rough estimate of overall workgroup costs required to develop the initial versions of working portals based on coordinated monitoring and assessment programs by assuming that 1/3 of portals will involve a level of effort equivalent to the Safe to Swim portal, 1/3 will require effort equal to that estimated by the Wetlands workgroup, and 1/3 will fall midway between these two extremes. This is equivalent to 10 portals at $90,000, 10 at roughly $1.2 million, and 10 at approximately $650,000. Basic costing assumptions are shown in Table 5 and estimated annual costs for ten years in Figure 10. Table 5 and Figure 10 show an increasing level of effort, peaking in years 6 and 7 and then declining to a maintenance level.

It is important to reiterate that the budget discussion here addresses only the resources needed to implement the Monitoring Council portion of effort involved in implementing the theme-based web portals. Recommendations regarding the funding and staffing levels needed by the Monitoring Council's partner member agencies to develop and implement the water quality monitoring and assessment programs needed to supply information to these portals has been deferred to future deliberations.

Table 5. Assumptions underlying the budget estimate in Figure 10. The number of new portals per year is shown as the number of low, medium, and high cost portals at, respectively, $90,000, $650,000, and $1.2 million per portal.

	Year									
Costing factor	1	2	3	4	5	6	7	8	9	10
# new portals	2, 2, 0	0, 1, 1	1, 1, 0	2, 1, 1	1, 1, 2	1, 2, 2	2, 1, 2	1, 1, 2	0	0
# workgroups	4	6	8	12	16	21	26	30	30	30
# Water Board staff	4	4	4	4	5	5	5	5	5	5



<Change "Water Board staff" to "Support staff" ?>

Figure 10. Summary budget estimate for Monitoring Council activities and portal development over the ten-year period encompassed by the Comprehensive Monitoring Program Strategy.

3.3.3. Contracting and implementation constraints

The Monitoring Council's funding strategy and its collaborative, workgroup approach to assessment and portal development depends on the Monitoring Council's ability to allocate funds to a variety of partners, both inside and outside of State agencies, and to build and maintain long-term relationships with these partners. Partners may be other state and federal agencies, academic scientists, universities, non-academic research entities, and private consultants. The past experience of programs within both Cal/EPA and the Natural Resources Agency has demonstrated that policies and procedures put in place by the Control Agencies (Department of Finance, Department of General Services, Department of Personnel Administration, Legislative Analyst's Office) have created contracting and implementation constraints that can severely limit the Monitoring Council's ability to fulfill its objectives.

Such constraints, as documented in the 2006 *Review of California's Surface Water Ambient Monitoring Program (SWAMP)* by the Scientific Planning and Review Committee, (SPARC 2006) include:

- Short limits on contract terms (one year for service contracts, three years for others)
- Long delays in implementing contracts
- A low ($5000) limit on sole-source contracts
- Strict limits on subcontracting

- A preference for low-bid proposals that ignores technical and scientific specialization and quality
- Unpredictable and increasing overhead costs, particularly for contracts managed through the California State University system
- Prohibitions on out-of-state travel that restrict the ability of technical staff to exchange ideas and learn from the experience of practitioners outside of California

The Monitoring Council concurs with the SPARC's findings that contract reform is needed to improve the effectiveness and efficiency of California's water quality monitoring and assessment programs.

Chapter 4: Recommendations

In the past year, the Monitoring Council has begun implementing the recommendations contained in its 2008 report to the Secretaries of Cal/EPA and the California Natural Resources Agency (CWQMC 2008). This effort focused on implementing four prototype theme-based web portals and has validated the efficacy of the Monitoring Council's overall approach to addressing the problems detailed in the legislation (CWQMC 2009), as well as the need for an entity such as the Monitoring Council to play a central coordinating role. The past year's experience has therefore provided the basis for the recommended Comprehensive Monitoring Program Strategy described in this document.

In order for the recommended Comprehensive Monitoring Program Strategy to be successfully implemented, the Monitoring Council recommends that:

- The Agency Secretaries endorse the Monitoring Council's vision of theme-based workgroups that operate under the Monitoring Council's guidance and make data and assessment results available through a coordinated series of web portals
- The Agency Secretaries endorse a central coordinating and facilitating role for the Monitoring Council that should be continued over the long term
- The Agency Secretaries continue to support the Monitoring Council's activities and require their boards, departments, offices, and commissions to actively participate in relevant workgroups
- The Agency Secretaries support the acquisition of long-term funding needed for implementation of the Comprehensive Monitoring Program Strategy
- The Department of Public Health be invited to sign the existing MOU between Cal/EPA and the Natural Resources Agency
- The monitoring and assessment efforts of SWAMP (see Appendix 5) be integrated into the Monitoring Council's recommended Comprehensive Monitoring Program Strategy, with SWAMP accepting primary responsibility for:
  - statewide assessment of the health of aquatic ecosystems in streams and rivers, including development of methods for bioassessment and biological objectives
  - statewide assessment of fish tissue contamination in both freshwater and marine habitats and impacts and threats to fishing-related beneficial uses
  - development of appropriate QA/QC protocols and providing assistance to others, including the QA Help Desk
  - continued implementation of the CEDEN network and associated data management functions and providing assistance to others, including the Data Management Help Desk
  - Providing assistance to local and regional citizen monitoring efforts through its Clean Water Team and regular informational webinars of the California Water Quality Monitoring Collaboration Network
- Monitoring of state funded water quality and ecosystem improvement projects should be coordinated and enhanced to ensure that the success of such projects is measured and that the generated data are available for use in larger-scale assessments. Changes should include
  - A cohesive, question-driven monitoring program
  - A unified monitoring design that ensures comparability
  - Persons or groups responsible for coordinating, collating, assessing and reporting these monitoring efforts

- The Monitoring Council's member agencies should seek approval for out-of-state travel for a number of staff to attend, at a minimum, the biennial National Water Quality Monitoring Conference
- The Monitoring Council should work with its member agencies, the Control Agencies, the Governor's Office, and the Legislature to identify ways to address the contracting and implementation constraints summarized above

References

California Water Quality Monitoring Council (CWQMC). 2008. Maximizing the Efficiency and Effectiveness of Water Quality Data Collection and Dissemination. Sacramento, CA. December 1, 2008.

California Water Quality Monitoring Council (CWQMC). 2009. 2009 Annual Progress Report of the California Water Quality Monitoring Council. Sacramento, CA. December 30, 2009.

Office of the Chief Information Officer for the State of California (OCIO). 2009. Statewide Data Strategy Report. Sacramento, CA. July 15, 2009.

Scientific Planning and Review Committee (SPARC). 2005. Review of California's Surface Water Ambient Monitoring Program (SWAMP). Technical Report #486 of the Southern California Coastal Water Research Project (SCCWRP). May 2006.

Appendix 1: SB 1070 Requirements Matched to Recommended Comprehensive Monitoring Program Strategy Components

The following table illustrates which aspects of the Monitoring Council's efforts to date address each specific requirement of SB 1070.

SB 1070 requirement	Detail	Status
Public information program on water quality	CWC §13167. … place and maintain on its Internet Web site a public information file on water quality monitoring, assessment, research, standards, regulation, enforcement, and other pertinent matters	Begun with creation of My Water Quality website and initial theme-based web portals; task of the State Water Board
Memorandum of Understanding	CWC §13181(a)(1) … the California Environmental Protection Agency and the [Natural] Resources Agency, on or before December 1, 2007, to enter into a memorandum of understanding for the purposes of establishing the California Water Quality Monitoring Council, which the state board would be required to administer.	MOU signed November 26, 2007 Monitoring Council held first meeting June 23, 2008
Monitoring Inventory	CWC §13181(c) The monitoring council shall undertake and complete, on or before April 1, 2008, a survey of its members to develop an inventory of their existing water quality monitoring and data collection efforts statewide and shall make that information available to the public.	Preliminary inventory completed June 28, 2008; updated as an appendix of the Recommendations Report of December 1, 2008
Recommendations report	CWC §13181(b) The monitoring council shall report, on or before December 1, 2008, to the California Environmental Protection Agency and the [Natural] Resources Agency with regard to its recommendations for maximizing the efficiency and effectiveness of existing water quality data collection and dissemination, and for ensuring that collected data are maintained and available for use by decision makers and the public.	Report submitted December 1, 2008
Recommend improvements to monitoring	CWC §13181(a)(4) The monitoring council shall review existing water quality monitoring, assessment, and reporting efforts, and shall recommend specific actions and funding needs necessary to coordinate and enhance those efforts.	First set of recommendations presented in December 1, 2008 report; more extensive recommendations to be submitted in Comprehensive Monitoring Program Strategy report scheduled for early 2010

	CWC §13181(a)(5)(A) The recommendations shall be prepared for the ultimate development of a cost-effective, coordinated, integrated, and comprehensive statewide network for collecting and disseminating water quality information and ongoing assessments of the health of the state's waters and the effectiveness of programs to protect and improve the quality of those waters. CWC §13181(a)(5)(B) For purposes of developing recommendations pursuant to this section, the monitoring council shall initially focus on the water quality monitoring efforts of state agencies, including, but not limited to, the state board, the regional boards, the department, the Department of Fish and Game, the California Coastal Commission, the State Lands Commission, the Department of Parks and Recreation, the Department of Forestry and Fire Protection, the Department of Pesticide Regulation, the State Department of Health Services, and the Department of Toxic Substances Control. CWC §13181(a)(5)(C) In developing the recommendations, the monitoring council shall seek to build upon existing programs rather than create new programs. CWC §13181(a)(6) ... the monitoring council shall formulate recommendations to accomplish both of the following: (A) Reduce redundancies, inefficiencies, and inadequacies in existing water quality monitoring and data management programs in order to improve the effective delivery of sound, comprehensive water quality information to the public and decision makers. (B) Ensure that water quality improvement projects financed by the state provide specific information necessary to track project effectiveness with regard to achieving clean water and healthy ecosystems.	
Develop a comprehensive monitoring program strategy	CWC §13181(e) ... the state board shall develop, in coordination with the monitoring council, all of the following: (1) A comprehensive monitoring program strategy that utilizes and expands upon the State's existing statewide, regional, and other monitoring capabilities and describe how the State will develop an integrated monitoring program that will serve all of the State's water quality monitoring needs and address all of the State's waters over time.	To be presented in the Comprehensive Monitoring Program Strategy report scheduled for early 2010

	The strategy shall include a timeline not to exceed 10 years to complete implementation. The strategy shall identify specific technical, integration, and resource needs, and shall recommend solutions for those needs.	
	CWC §13181(f) … identify the full costs of implementation of the comprehensive monitoring program strategy developed pursuant to subdivision (e), and shall identify proposed sources of funding for the implementation of the strategy, including federal funds that may be expended for this purpose.	Task of the State Water Board
Develop an agreement on Indicators	CWC §13181(e)(2) Agreement, including agreement on a schedule, with regard to the comprehensive monitoring of statewide water quality protection indicators that provide a basic minimum understanding of the health of the state's waters. Indicators already developed pursuant to environmental protection indicators for statewide initiatives shall be given high priority as core indicators for purpose of the statewide network.	Under development through the efforts of individual theme-based workgroups
Develop a Quality Assurance Management Plan	CWC §13181(e)(3) Quality management plans and quality assurance plans that ensure the validity and utility of the data collected.	Under development through the efforts of individual theme-based workgroups, complemented by the SWAMP and CEDEN quality assurance efforts
Develop a method for compiling, analyzing, and integrating readily available information	CWC §13181(e)(4) This is to include data from waste discharge reports; volunteer monitoring groups; local, state, and federal agencies; and state and federal grant recipients of water quality improvement projects.	Under development through the efforts of individual theme-based workgroups. This will be complemented by a planned data management and integration workgroup, which will identify data elements that must be more broadly integrated to address larger scale and more complex questions
Develop an accessible and user-friendly electronic Data Management System	CWC §13181(e)(5) To the maximum extent possible, include the geospatial information on the data sites.	Being implemented on the individual theme-based web portals
Develop a method for producing timely and complete water quality reports and lists	CWC §13181(e)(6) The reports and lists required are those required under Sections 303(d), 305(b), 314, and 319 of the Clean Water Act, and Section 406 of the BEACH Act.	Under development as part of the reporting features of individual theme-based web portals
Develop an update of the SWAMP needs assessment	CWC §13181(e)(7) The SWAMP program needs will change in light of the benefits of the increased coordination and integration of information from	To be included as part of the Monitoring Council's Comprehensive Monitoring Program Strategy to be

other agencies and information sources. delivered in early 2010

Appendix 2:

California Water Quality Monitoring Council Annual Progress Report December 2009

Executive Summary

The California Water Quality Monitoring Council has met key benchmarks in the legislation (Senate Bill 1070; Kehoe, 2006) by completing a memorandum of understanding between Cal/EPA and the California Natural Resources Agency in November of 2007 and by submitting a key recommendations report in December of 2008. In early 2010, the Monitoring Council will submit its comprehensive monitoring program strategy for meeting most of the legislation's goals over a ten-year timeframe. Specific accomplishments also include:

- Creating four theme-based workgroups that validated the broad applicability of the collaborative workgroup approach to coordination and web portal development
- Clearly identifying, through the workgroup process, gaps in data acquisition, monitoring coverage, and management responsibility
- Implementing a single point of access, through the Monitoring Council's *My Water Quality* web page, to organized monitoring data, assessment products, and useful background information
- Developing and releasing two theme-based web portals (Safe to Swim and Safe to Eat Fish and Shellfish), with two additional portals scheduled for early 2010, (Wetlands and Safe to Drink Groundwater). These are organized around a small set of core, high-priority questions that provide ready access to monitoring and assessment results
- Developing draft design guidance for future web portals, emphasizing a question-driven structure, map-based assessment products, and direct access to underlying data
- Conducting successful preliminary discussions with several additional monitoring efforts that will provide the focus for the next phase of web portal development
- Achieving tangible improvements in coordination among local, state, federal, and non-governmental agencies
- Making progress on developing and implementing coordinated and/or standardized monitoring designs for beach water quality sampling, seafood tissue contaminant assessment, and wetlands project tracking and overall assessment
- Demonstrating how the web portals, based on improved data acquisition and integration, can increase the efficiency of both routine and ad hoc reporting

The Monitoring Council's next steps include completing the comprehensive monitoring program strategy report; formalizing relationships with the next set of theme-based workgroups; and further developing a statewide data management strategy in cooperation with Cal/EPA, the

Natural Resources Agency, and the Office of the Chief Information Officer. In addition, the Monitoring Council will continue to provide logistical and management support to existing workgroups as they address issues identified in 2009. This process will require that the Monitoring Council continue to develop and define its coordinating and advocacy role with respect to other agencies. Finally, the Monitoring Council will use the more detailed comprehensive strategy as a basis for funding requests needed to support the full implementation of the strategy called for in the legislation.

Foreword

This report is the first in a series of annual reports summarizing the California Water Quality Monitoring Council's progress toward implementing the requirements of Senate Bill 1070 (Kehoe, 2006). SB 1070 identified a number of goals and actions intended to improve the efficiency and effectiveness of water quality and associated aquatic ecosystem monitoring, and to provide broader access to monitoring data and assessment results. The legislation required that the California Environmental Protection Agency (Cal/EPA) and the California Natural Resources Agency enter into a Memorandum of Understanding establishing the California Water Quality Monitoring Council (Monitoring Council), to be administered by the State Water Resources Control Board. The MOU was signed November 26, 2007. SB 1070 also requires that "the monitoring council shall review existing water quality monitoring, assessment, and reporting efforts, and shall recommend specific actions and funding needs necessary to coordinate and enhance those efforts." The legislation goes on to say, "[t]he recommendations shall be prepared for the ultimate development of a cost-effective, coordinated, integrated, and comprehensive statewide network for collecting and disseminating water quality information and ongoing assessments of the health of the state's waters and the effectiveness of programs to protect and improve the quality of those waters." These recommendations were presented by the Monitoring Council in its December 1, 2008 to Cal/EPA and the Natural Resources Agency, which included the following commitment:

> On an annual basis, beginning in December 2009, the Monitoring Council will report back to the agency secretaries on progress made in implementing the Council's vision, and in a manner that supports Cal/EPA's conduct of a triennial audit of the effectiveness of the comprehensive monitoring program strategy, as called for in the legislation.

This report provides a summary of progress achieved since December 2008 in implementing the recommendations contained in the December 2008 report; a companion report targeted for March 2010 will present the Monitoring Council's comprehensive monitoring program strategy.

The Monitoring Council's Five-Part Solution

SB 1070 described a set of fundamental issues that have prevented the State from making the most effective and efficient use of the extensive water quality monitoring conducted by permittees; local, state, and federal agencies; and others such as citizen monitoring groups. The Monitoring Council believes that a primary focus on technical tools, though important, would not directly address these issues because it would not be driven by end users' perspectives. The Monitoring Council's solution to the monitoring coordination and data access problems therefore is centered on delivering data to those people who need it in ways that directly address their key questions. The essential components of this concept include a template for web-driven, user-oriented data access portals that are developed and implemented by a series of issue-specific workgroups operating under the Monitoring Council's overall guidance and approval.

This process will promote efficiency by highlighting where (and only where) improved coordination of monitoring methods and data management approaches is necessary for meeting users' needs. Developing these coordinated methods and approaches will be the responsibility of the issue-specific workgroups, working within general guidelines set by the Monitoring Council. The five elements necessary for realizing this vision include:

- An organizational structure built on decentralized, issue-specific workgroups that operate within common policies and guidelines defined by the Monitoring Council
- A set of performance measures which each theme-based workgroup will use to evaluate, coordinate and enhance monitoring, assessment, and reporting efforts
- A single, web-based, global point of entry to water quality data, and a design template for the complete set of theme-based web portals
- Coordination of monitoring and assessment methods that achieves an appropriate balance between statewide consistency and regional flexibility
- Database and data management protocols necessary for more efficient data access and integration

Progress to Date

The following sections describe progress achieved during 2009 for each of the five elements of the Monitoring Council's strategy and demonstrates how these accomplishments provide a proof of concept of the strategy and lay the groundwork for further progress in the future.

Issue-specific workgroups

Collaborative theme-based workgroups are a core piece of the Monitoring Council's strategy and the vehicle through which much of the Monitoring Council's efforts to improve monitoring coordination and access to data will be accomplished. In 2009, the Monitoring Council, building on existing efforts, identified four prototype theme-based workgroups (Safe to Swim, Safe to Eat Fish and Shellfish, Wetlands, Safe to Drink Groundwater) that succeeded in validating the utility and broad applicability of the workgroup approach in a range of technical, regulatory, and institutional settings. This initial set of workgroups leveraged existing efforts at regional and statewide coordination, provided a mechanism for enlisting additional participants, and broadened working relationships among state and federal agencies, permittees, researchers, and others such as NGOs. As described in the following paragraphs, workgroups also identified key gaps in data acquisition, monitoring coverage, and management responsibility that helped to prioritize additional efforts planned for the future. The success of the four prototype workgroups has led to fruitful discussions with groups active in other areas that will shortly lead to the formal establishment of additional workgroups. The following paragraphs illustrate this progress with representative examples.

The Safe to Swim workgroup built on the existing Beach Water Quality Workgroup for southern California and the Central/Northern California Ocean and Bay Water Quality Monitoring Group, integrating them into a more cohesive statewide entity that has formally agreed to manage the continued development and maintenance of the web portal in conjunction with the State Water Board, U.S. EPA, the Southern California Coastal Water Research Project (SCCWRP), and Heal the Bay. The Safe to Swim workgroup accelerated coordination among permittees, county public health agencies, environmental groups, and the State Water Board. However, these efforts, and the data management, assessment, and reporting tools built to support them, have

historically focused primarily on ocean beaches. The Monitoring Council's broader emphasis on a statewide perspective resulted in the identification of other monitoring efforts, particularly those focused on inland freshwater swimming locations, that must be included in the web portal in order to present a truly statewide picture of swimming conditions (Figure 1). Future efforts of the Safe to Swim workgroup will focus on filling these gaps in data acquisition and data integration. In addition, portal development caused the workgroup to recognize that the existing beach water quality and closure/posting data management structure was in need of an overhaul. As a result, a new Beach Watch database and data sharing protocols will be developed over the next year at SCCWRP to enhance the flow of data from county health agencies to the State, U.S. EPA, Heal the Bay, and the Safe to Swim portal. By enhancing the ability of data generators to manage their data more easily, the new system is expected to encourage more real-time data availability and streamline reporting efforts.

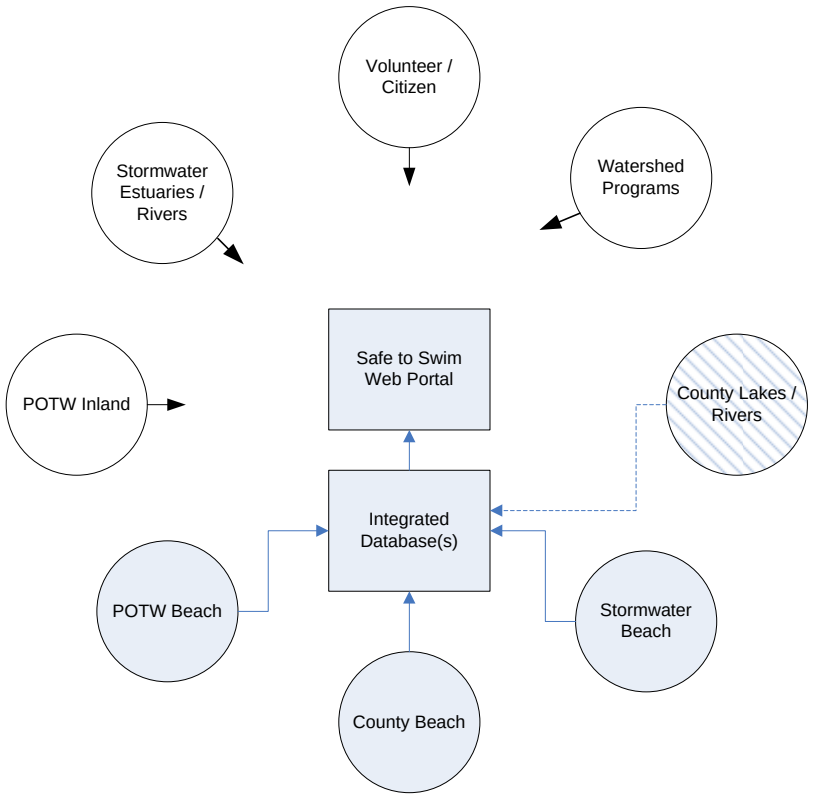


Figure 1. *Schematic illustration of the categories of monitoring programs that produce data relevant to the Safe to Swim web portal. Past efforts at collecting monitoring data in an integrated statewide database have focused on ocean beaches, and some few county-level monitoring programs at lakes and rivers. Data from other significant freshwater monitoring efforts have yet to be addressed. The workplan for this theme therefore includes efforts to incorporate data flows from these remaining program types into the web portal.*

The Safe to Eat Fish and Shellfish workgroup built on the existing Bioaccumulation Oversight Group (BOG), which has become an integral part of statewide assessments of fish and shellfish tissue contamination, coordinated by the State Water Board's Surface Water Ambient Monitoring Program (SWAMP). These efforts include a 2007 – 2008 survey of 280 lakes and reservoirs, and an upcoming survey of coastal waters being coordinated with the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Fish and Game, the San Francisco Estuary Institute (SFEI), and SCCWRP. SWAMP's success at bringing these parties together led to creation of the BOG, which has formally agreed to manage the continued development and maintenance of the Monitoring Council's Safe to Eat web portal. As an example of this improved coordination, the statewide lakes survey produced data that OEHHA used in 2009 to help update existing fish consumption advisories. The workgroup also acted as a vehicle, with Monitoring Council involvement, for crafting a more comprehensive and integrated set of information products for managers, the public, and other users (see *Combining Multiple Agency Perspectives*, next page).

The Wetlands workgroup also built on an existing effort, the California Wetlands Monitoring Workgroup (CWMW) that includes over 20 state, federal, and local entities, both public and private. This workgroup has made substantial progress toward including the large number of agencies involved in wetland monitoring, restoration, and management and is the only venue where these entities come together to collaborate on such issues. The workgroup has achieved important agreements on defining standardized wetland definitions, monitoring approaches, and assessment and reporting methods (see Coordination and Standardization, below) that could provide the basis for a statewide wetlands assessment program. However, in defining these approaches, and in preparing a comprehensive report on the State of the State's Wetlands, the workgroup highlighted the lack of a coordinated statewide policy for monitoring and assessing the extent and condition of California's wetlands. Currently, responsibility for various functions is divided among a number of state, federal, and local agencies, with no overarching assessment and reporting framework. In response, the CWMW has assisted in proposing a coordinated management structure that allocates complementary monitoring and assessment functions to the State Water Board, Department of Fish and Game, Regional Water Boards, and other agencies, including individual wetland project managers.

Combining Multiple Agency Perspectives

Development of the Safe to Eat Fish and Shellfish web portal, with its goal of providing a single point of access to data and information, highlighted different assessment and data presentation approaches used by the State Water Board and OEHHA. In the past, these differences were reflected in each agency's separate documents and information products, with little or no synthesis or explanation of how the agencies' different perspectives were related.

As the Safe to Eat Fish and Shellfish web portal was being developed, OEHHA staff expressed several significant concerns, especially about the way data and assessment results were portrayed and about the potential for confusion due to the inclusion of multiple perspectives in a single location. Subsequent discussions among the Monitoring Council, OEHHA, the State Water Board, and the BOG helped the Monitoring Council clarify its approach to presenting assessment findings. This resulted in a web portal that displays alternative views of the monitoring data and explains the different but complementary assessment approaches on which they are based.

As a result, managers, the public, and other interested parties can now find, for the first time and in one place, a consolidated set of data, assessment products, and background information related to fish and shellfish consumption. For example, local health agencies and non-governmental agencies now have more streamlined access to information useful in protecting the most vulnerable populations who often include local fish and shellfish in their diet.

However, these discussions about the web portal also highlighted the fact that SWAMP's statewide monitoring surveys, conducted to assess water quality (i.e., patterns of contamination), do not produce the more comprehensive and detailed data OEHHA needs for developing consumption advisories. From OEHHA's perspective, SWAMP's surveys are useful screening tools, but the absence of a mechanism for regularly acquiring this more detailed information is a data gap that limits agencies' ability to fully answer the web portal's core questions.

Creation of the Safe to Drink web portal has focused initially on groundwater, an area where the State Water Board, the Department of Public Health (DPH), the Department of Pesticide Regulation, the Department of Water Resources, the U.S. Geological Survey, and the Lawrence Livermore National Labs have long worked together. However, developing the web portal led them to begin thinking about common ways of accessing and presenting monitoring information, which required creation of an expanded collaborative relationship among the State Water Board's Office of Information Management and Analysis, its Ground Water Quality Branch, and its outside partners. The initial focus of this effort has been to adapt the existing GeoTracker

GAMA website toward the Monitoring Council's question-driven user interface and to begin discussions about how to better assess connections between groundwater and drinking water quality. In addition, security concerns prevent displaying the precise location of public drinking water supply wells on the web portal maps. The agencies involved have worked to investigate ways of meeting these security concerns without obscuring other information on the maps and while still providing users with useful information. With this core set of relationships established, the workgroup may expand its membership to include other entities contributing monitoring data, such as the Department of Toxic Substances Control, as well as other users of the system.

The initial four workgroups, intended as a proof of concept, have worked as planned to coordinate and expand existing efforts, recruit new participants, highlight data and management gaps, and catalyze solutions to a range of problems. They have also provided the Monitoring Council with opportunities to better define its role in facilitating problem-solving efforts, bringing higher-level management attention to bear where needed, creating policies and procedures to guide workgroup efforts, and engaging the collaboration of non-state entities such as SFEI, SCCWRP, and Heal the Bay. This will be instrumental to future progress as additional themes are targeted for development that do not necessarily have preexisting workgroup structure on which to build. In preparation for the next round of workgroup creation and web portal development, the Monitoring Council has begun a formal outreach process to other state agencies and departments, and has also held preliminary discussions with a number of existing or nascent regional and statewide monitoring and assessment programs. These include marine rocky subtidal reefs, the Multi-Agency Rocky Intertidal Network (MARINe), harmful algal blooms, kelpbeds, the State Water Board's Sediment Quality Objectives program for enclosed bays and estuaries, SWAMP's Healthy Streams Initiative, and the Interagency Ecological Program (IEP) in the San Francisco Bay / Delta.

Performance measures

The Monitoring Council understands the importance of explicit benchmarks for success, which can be used both to assess the status of themes as they are prioritized for workgroup formation and web portal development and to track progress toward achieving the legislation's goals. In its December 2008 recommendations report, the Monitoring Council identified a set of six performance measures related to:

- Program strategy, objectives, and design
- Indicators, methods, and QA/QC
- Data management
- Consistency of assessment endpoints
- Reporting and access
- Program sustainability

and described specific benchmarks for rating the degree to which each performance measure is being met by individual theme-based monitoring and assessment programs. These performance measures are based on the U.S. EPA's ten design elements for monitoring, assessment, and reporting programs and directly address the legislation's requirements in terms of indicators, quality control, data analysis and integration, data management and access, and reporting. They have provided the conceptual structure for evaluating each workgroup's progress and prioritizing areas where additional development is needed. The Monitoring Council is

incorporating the performance measures into its ongoing evaluation of each workgroup's progress and is encouraging workgroups to use them in managing their own individual efforts.

The performance measures provide a standardized framework for evaluating monitoring, assessment, and reporting programs. While such design principles have long been recognized, the Monitoring Council is in a unique position to help ensure they are applied consistently and rigorously across the full range of water quality monitoring and assessment programs statewide.

Single point of entry

A central design feature of the Monitoring Council's approach is that all theme-based web portals, and the water quality data and assessment products they provide, will be accessible through a single, global point of entry. This point of entry has been established as the *My Water Quality* website at http://www.waterboards.ca.gov/mywaterquality (Figure 2) and two of its web portals have gone "live" and been released to the public: Safe to Swim on July 28 and Safe to Eat Fish and Shellfish on December 8. A Wetlands portal is due to be released in January 2010 and a fourth prototype portal, Safe to Drink Groundwater, is also scheduled to be released in early 2010. The Monitoring Council has been tracking detailed web portal use statistics since August 26. In that period, nearly 2,000 unique visitors created over 16,000 page views primarily on the Safe to Swim web portal, distributed across the separate assessment questions within that theme.

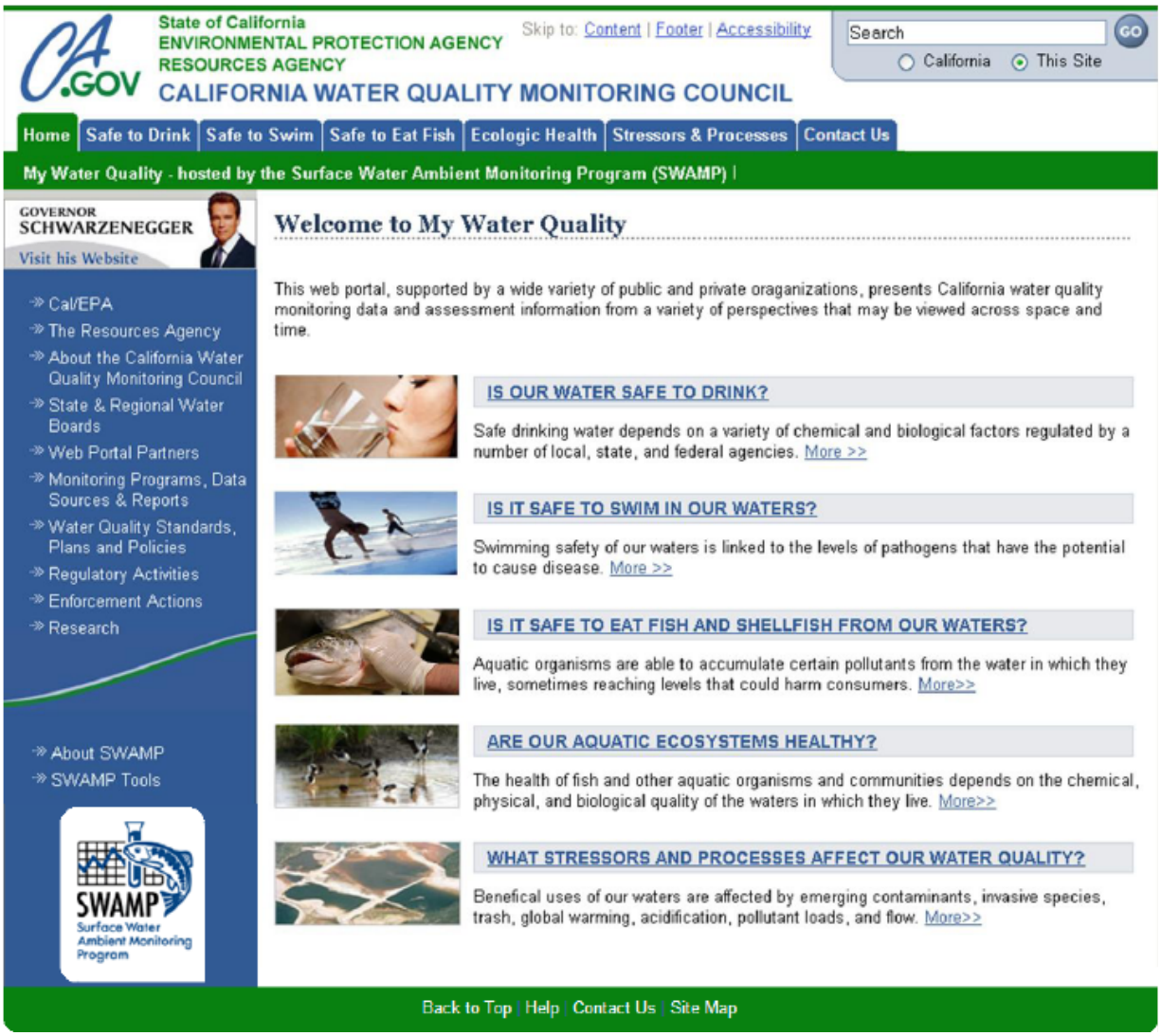


Figure 2. *The Monitoring Council's global point of entry to monitoring and assessment information for all theme-based web portals.*

The Monitoring Council's *My Water Quality* website, and the individual theme-based portals accessible through this global point of entry, are structured around explicit assessment questions that reflect key information needs of managers, scientists, and the public. Where this requires links to databases and websites maintained by other entities, this is accomplished within the question-driven structure of the web portal. This approach enables users to more easily find answers to their concerns and solves the long-standing, fundamental data access problem described in the legislation, namely, that it can be confusing and time consuming to find data, assessment products, and background information relevant to a particular question or issue.

Based on experience with the four prototype web portals, the Monitoring Council is developing guidelines for workgroups to follow as they develop additional web portals and intends to formalize these guidelines early in 2010. The guidelines include structure and content (e.g., question driven, statewide scope, multiple perspectives permitted), format (e.g., map-based

interfaces, data download links), and process (e.g., Monitoring Council review and approval). The Monitoring Council intends that these guidelines promote a consistent look, feel, and functionality across all web portals in order to promote ease of use.

The process of organizing diverse data and information sources into one web portal is helping the Monitoring Council's workgroups to identify opportunities for improved coordination, integration (Figure 1), and streamlining of both monitoring designs and assessment protocols (see *Coordination and Standardization*, below), and to highlight where important data gaps remain. In addition, the availability of the web portals as a single point of entry to data access and reporting tools has begun, as intended, to catalyze improvements to these activities. As discussed under Issue-Specific Workgroups above, for example, the Safe to Swim workgroup, with support from the Monitoring Council, has defined a much more efficient data submission, data management, and reporting procedure. When implemented, this will dramatically improve the efficiency of day-to-day data transfer and integration functions as well as of the State's reporting to U.S. EPA and others on beach water quality. Similarly, full implementation of the Wetlands web portal, with its Wetland Tracker features, will substantially improve agencies' and project managers' ability to quickly summarize information on wetland extent and condition.

Coordination and standardization

One of SB 1070's key goals is to improve the overall effectiveness of water quality and aquatic ecosystem monitoring and assessment by addressing the widespread lack of coordination and standardization across separate programs. Past experience shows that improved coordination can increase the quality of assessments, along with their efficiency and reliability, along the entire data path from sampling through analysis and reporting. The Monitoring Council's theme-based approach, which is centered on workgroups and web portals, has demonstrated the validity of this strategy by identifying specific opportunities for improved coordination and providing a structure for taking advantage of these opportunities.

The Monitoring Council's decision to focus workgroup efforts and web portal development on explicit assessment questions has provided much needed focus to current coordination and standardization efforts at the statewide scale. This decision means that workgroups, Monitoring Council staff, and data managers need no longer struggle to coordinate and/or standardize all monitoring efforts and all monitoring data statewide. Instead, they can concentrate on those monitoring elements and data types that are essential to answering high-priority assessment questions, with a concomitant increase in overall efficiency, as illustrated in the following examples.

At the level of individual themes, the Wetlands workgroup has focused on developing a common assessment approach (California Rapid Assessment Method (CRAM)) to be used for all wetland projects and is working on common monitoring guidelines for use in state and federal management programs. With more than 20 members representing local, regional, state, and federal interests, the workgroup has also provided a vehicle for engaging high-level state and federal managers in key issues such as a definition of wetlands to be used by federal agencies such as the U.S. Army Corps of Engineers and state agencies such as Fish and Game and the State Water Board (see *Theme-Based Workgroups: Forums for Collaboration*, next page). When fully implemented, common wetland definitions, monitoring designs, and assessment approaches will provide important foundational elements for a statewide wetlands management program. The Wetlands workgroup is developing a detailed proposal for such a program, which will be submitted to Cal/EPA and the Natural Resources Agency in early 2010. An important feature of the workgroup process and the web portal's structure is the flexibility to include new

Theme-Based Workgroups: Forums for Collaboration

Wetland definitions (what is or is not a wetland) and classifications (descriptions of different wetland types) are highly technical but fundamentally important to agencies' ability to coordinate monitoring and to create integrated maps of wetland extent and assessments of wetland condition. This is because, for example, different definitions or classifications can lead to dissimilar or conflicting boundaries, both for wetlands as a whole and for habitat types within wetlands. This can lead to incompatible results when calculating changes in wetland area or integrating assessments of habitat condition across multiple wetlands or studies.

The CWMW has, therefore, become a key forum in which agencies and other parties collaborate on a common definition and classification system for California. The Interagency Policy Development Team has tasked a Technical Advisory Team (TAT) with recommending a wetland definition that is consistent with that of the Corps of Engineers, but includes modifications to fit circumstances in California. The CWMW has involved senior Corps staff in this effort and CWMW scientists have been directly involved in preparing the draft definition and in obtaining input from other agencies such as U.S. EPA. Development of the associated classification systems is in process and should be completed in 2010.

The CWMW is thus acting as a clearinghouse for an interagency technical review overseen by an Interagency Coordinating Committee. This process is unavoidably complex and time consuming. However, it has achieved agreement by the federal agencies on the Interagency Coordination Committee, particularly the three Corps districts in California and their regional regulatory Branch Chiefs, with the wetland definition recommended to the State Water Board by the TAT.

wetland environments, such as alpine meadows, as needed. As another example of the benefits of standardization, the Wetland Tracker database, used to collect and organize information on wetland projects, is being slightly modified for use by a regional eelgrass monitoring program being developed for southern California with support from the National Marine Fisheries Service. As another example, the Safe to Swim workgroup is continuing to develop and implement standardized data management and data transfer protocols that will greatly improve the efficiency and reliability of data aggregation at the statewide level. This effort will increase coordination among monitoring programs managed by county public health agencies, permitted dischargers, the State and Regional Water Boards, and environmental groups and has resulted in broad support for a single access point for monitoring data statewide.

Finally, the Safe to Eat Fish and Shellfish workgroup is building on SWAMP's core statewide monitoring and assessment approach, in which probabilistic sampling networks provide a broad overview of status and trends, and help to identify locations where more intensive targeted sampling may be needed to support the development of consumption advisories . The workgroup has enabled a new level of coordination between OEHHA and the State Water Board that resulted in statewide data products such as that illustrated in Figure 3 that could lead to more integrated assessment approaches.

Data management

Data management provides the technical underpinning for all other Monitoring Council and workgroup efforts. Coordination across programs, creation of statewide assessment perspectives, centralized access to data through the web portals, and automated report generation all depend on effective data management systems that collect, store, transfer, integrate, and provide ready access to validated and well documented monitoring data and assessment products. The Monitoring Council's strategy is to build on existing systems and data

management capabilities wherever possible, building additional functionality only where needed. This strategy has the following essential elements:

- Identifying data types and data sources essential to answering each theme's core assessment questions
- Defining quality control and data formatting requirements where these do not yet exist
- Creating data integration procedures required for combining multiple data types into coordinated assessments
- Ensuring that all essential data have a home, either in existing data systems or at one or more of the regional data centers planned as pieces of the California Environmental Data Exchange Network (CEDEN)
- Building linkages among data sources to support statewide data integration and assessment
- Building and maintaining working relationships needed to successfully implement the elements of the data management strategy

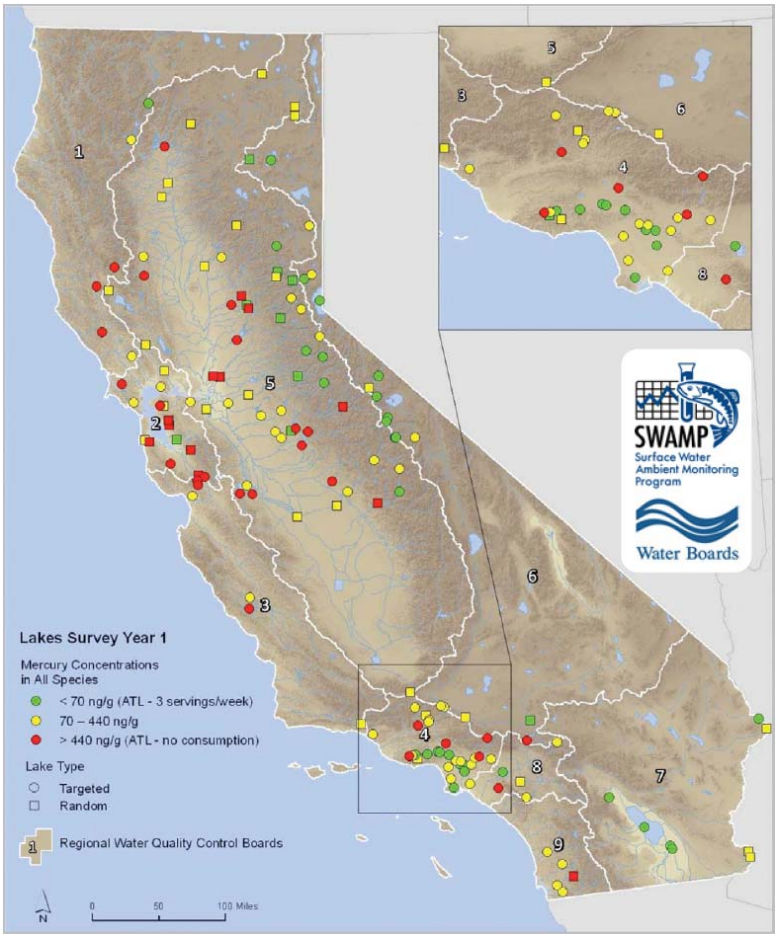


Figure 3. *Highest species average mercury Concentrations, based on data from a statewide screening level survey conducted by the State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP). Fish tissue concentrations were compared with thresholds developed by the Cal/EPA Office of Environmental Health Hazard Assessment (OEHHA).*

The Monitoring Council has used its experience during the past year with the four prototype web portals to define its overall data management strategy, to begin establishing relationships with other data managers both inside and outside of state agencies, and to begin discussions with these managers about the role of a data management workgroup. Because the Monitoring Council believes that its data management strategy should correspond to the types of issues likely to arise during the workgroup and web portal development process, the development of the data management strategy has necessarily lagged to some degree the implementation of the initial four prototype portals. In addition, completion of the CEDEN network and its regional data centers is contingent on funding beyond what is currently available to the Monitoring Council and the State Water Board.

Summary and Next Steps

By establishing four theme-based workgroups and creating prototype web portals for each, the Monitoring Council confirmed the utility of its strategic approach. Each workgroup achieved significant progress toward resolving the set of issues and problems identified in the legislation and meeting its overall goals of improving data access and the coordination of monitoring and assessment programs. This progress includes the creation of new statewide assessments; improved collaboration and coordination among multiple state, federal, and local programs; agreement on standardized monitoring and assessment approaches; increased efficiency of data acquisition and reporting; and simplification of data access through use of the web portals. These accomplishments were achieved with existing funding and staffing, by building in part on existing efforts and targeting “low hanging fruit” for the initial set of prototypes. Maintaining what has been achieved, completing development of the four prototype web portals, expanding the Monitoring Council’s efforts to the full set of themes identified in the December 2008 recommendations, and establishing the programmatic and data management infrastructure needed to support these activities, will require additional effort, funding, and staffing beyond what has been available to date. These requirements are detailed in the Monitoring Council’s Comprehensive Monitoring Program Strategy, to be delivered in early 2010. In particular, the Monitoring Council has stressed the importance of outreach, relationship building, and coordination with other state, federal, and local agencies involved in monitoring and assessment. In addition, the Monitoring Council must develop measures to track its own performance against the goals of the legislation and the activities and benchmarks described in its upcoming Comprehensive Strategy.

Appendix 1: SB 1070 requirements
(see Appendix 1 above)

Appendix 3: Guidelines for Workgroups and the Development of *My Water Quality* Theme-Based Internet Portals

Background & Purpose

The California Water Quality Monitoring Council is forming workgroups to address California's need for timely and transparent information about water quality and associated ecosystem conditions. These guidelines explain the path to becoming a successful partner in the effort to accurately portray the best available information on water quality and the health of our aquatic ecosystems.

Senate Bill 1070 (Kehoe, 2006) required that the California Environmental Protection Agency (Cal/EPA) and the California Natural Resources Agency enter into a Memorandum of Understanding (MOU) establishing the California Water Quality Monitoring Council. The legislation and MOU mandated coordination of water quality monitoring and assessment activities among organizations both inside and outside state government, and that this information be made available to decision makers and the public via the Internet. As stated in its December 2008 recommendations report to the Secretaries of Cal/EPA and the Natural Resources Agency, a key component of the Monitoring Council's vision for enhancing California's system for water quality monitoring, assessment and reporting is the development of a single point of entry to set of Internet portals that connect decision makers and the public with water quality and related ecosystem health information. Each portal is developed by an expert stakeholder workgroup and includes interactive maps and monitoring data that focus on a specific water quality or aquatic ecosystem theme. The goal is to present this information in a timely and user-friendly manner that directly addresses users' questions.

A Monitoring Council workgroup is composed of experts representing a variety of agencies and entities, both within and outside state government, who are involved or have expertise in water quality and/or aquatic ecosystem monitoring and assessment that relates to a specific theme (e.g., the safety of eating fish from our waters). Under Monitoring Council oversight, the workgroup uses their collective scientific interest and capacity to design, develop and maintain an Internet portal focused on their theme, thereby bringing monitoring and assessment information to the public in an easily understood manner.

The goal of the portal is to convey relevant and timely information about the thematic area, in a variety of spatial and temporal scales, to agency decision makers, legislators, and the public. The portal should directly address users' questions, as well as supply relevant background technical information. As a portal is developed, maintained and enhanced, the workgroup strives to concurrently enhance the associated monitoring and assessment efforts that underlie the portal. This may include coordinating monitoring and assessment activities, discovering and breaking down existing barriers to information sharing, and enhancing the efficiency and effectiveness of monitoring, assessment, and reporting for their theme. The workgroup seeks to achieve the level of standardization necessary to meet the needs of the information users. The Monitoring Council establishes common policies and guidelines for the workgroups and the monitoring programs they represent, and acts as a clearinghouse for standards, guidelines, and collaboration.

Workgroup Formation & Function

A workgroup may begin as an existing group or organization that seeks Monitoring Council guidance and direction in return for the increased exposure and recognition that result from

publication of an Internet portal accessed through the *My Water Quality* website (www.CaWaterQuality.net). Alternatively, workgroups may be organized *de novo* by the Monitoring Council to tackle a specific water quality or related ecosystem theme.

Initially, the workgroup asks itself a number of questions, designed to help identify its focus and representation.

1) What is the scope of the assessment that will be presented?
(e.g., streams vs. wadeable streams, beaches vs. ocean beaches)
   a) Short-term focus – What relevant and timely information of sufficient quality is readily available in a form and condition that can be displayed in the initial portal roll-out?
   b) Longer-term focus – What information is needed to more fully and effectively cover the theme?
2) What are the questions that the workgroup is trying to answer about their theme? These should reflect common public questions and key agency management and legislative goals. These questions become the subjects of individual portal pages.
3) Who is the target audience?
Again, this may be subdivided into short- and long-term.
   a) Public
   b) Legislature
   c) Agency decision makers

   } minimum required pursuant to SB 1070

   d) Water quality/watershed management scientists and practitioners
   e) Agency staff performing assessments, evaluating conservation investments, writing permits, developing local land and water use ordinances, taking enforcement, etc.
   f) Non-governmental organizations (e.g., Heal the Bay, Waterkeepers, SCCWRP, SFEI, citizen monitoring groups)
   g) Regulated community
4) Needs Identification
   a) What data sets and assessment tools are needed to effectively respond to the questions being addressed?
   b) Who are the key players, i.e., the sources of relevant data and assessment tools? The answer should inform the workgroup to appropriately expand its membership.
   c) What other workgroups share overlapping subject matter (e.g., related ecosystem health themes)? These workgroups need to establish relationships for cooperation, developing mechanisms for data sharing and dynamic linkages between their portals, and avoiding unnecessary redundancy.

5) Problems Assessment

   a) What are the potential barriers to success?

      (1) Institutional (e.g., data ownership, data access)

      (2) Technical (e.g., data management, web capabilities, GIS and database platform differences)

      (3) Funding / resources

   b) Are there critical players who are unable or unwilling to participate?
   The Monitoring Council should be able to help to correct these problems by bringing responsible entities to the attention of agency secretaries.

6) Outreach – Sustainability hinges on getting the portals woven into the fabric of each agency's programs. Based on guideline #4(b) and (c) above, the workgroup needs to market their portal development and coordination efforts to partner agencies, with the goals of improving participation, sharing data, making linkages between agency web sites, and using the portal as part of each agency's program implementation. Stress how each organization benefits from the effort. Fostering these relationships is an important goal of the workgroups.

7) Each workgroup should review existing assessments and their underlying monitoring programs within its thematic area, provide critical review and comment (e.g., biases, data gaps, redundancies, comparability issues), and encourage improvement over time.

   a) Are existing monitoring and assessment programs able to adequately address key public and resource management questions?

      - What do we do well?
      - What is not being addressed?

   b) What needs to be done to correct the problems or improve performance?

   A detailed critique should be sent to the Monitoring Council with recommendations for agencies/organizations responsible for the assessments. The performance measures provided in the December 2008 Monitoring Council recommendations report (see Section 2.1.2 and Appendix 3) should be used to structure the evaluations.

8) Assessment Threshold Review – A key component of coordination provided by theme-based workgroups involves the thresholds used to assess collected monitoring data and to answer relevant questions on a variety of spatial and temporal scales.

   a) Have commonly accepted metrics and thresholds been developed, if not why, and what can be done to establish them?

   b) What are the pros and cons of existing published thresholds?

   c) What statutory and regulatory requirements must be met in the selection of existing and future thresholds?

   Each workgroup should develop recommendations to the Monitoring Council for making assessment thresholds more uniform across agencies and organizations involved in a particular theme. Recommendations must reflect the requirements of adopted statutory and regulatory mandates and consider regulations under development by potentially affected agencies. The Monitoring Council will, in turn, make recommendations to the appropriate agencies & organizations.

Portal Focus and Content

9) The central theme of each portal is expressed as a broad question, as presented on the *My Water Quality* home page (www.CaWaterQuality.net), shown in Figure 1 below. Alternatively, a portal may focus on a particular water body type within one of these main questions, e.g., a groundwater focus under the broader question of "Is our water safe to drink?" or a wetlands focus under the broader question of "Are our aquatic ecosystems healthy?"

10) Each portal should inform a wide range of audiences, including the general public, agency decision makers, legislators, and scientists (see guideline #3 above). First present more generalized assessment products that address a broader audience. Allow users to drill down to more detailed information that relates to their specific interests.

11) The portal home page should present several more-detailed questions (developed in guideline #2 above). These act as links to additional pages in the portal that present

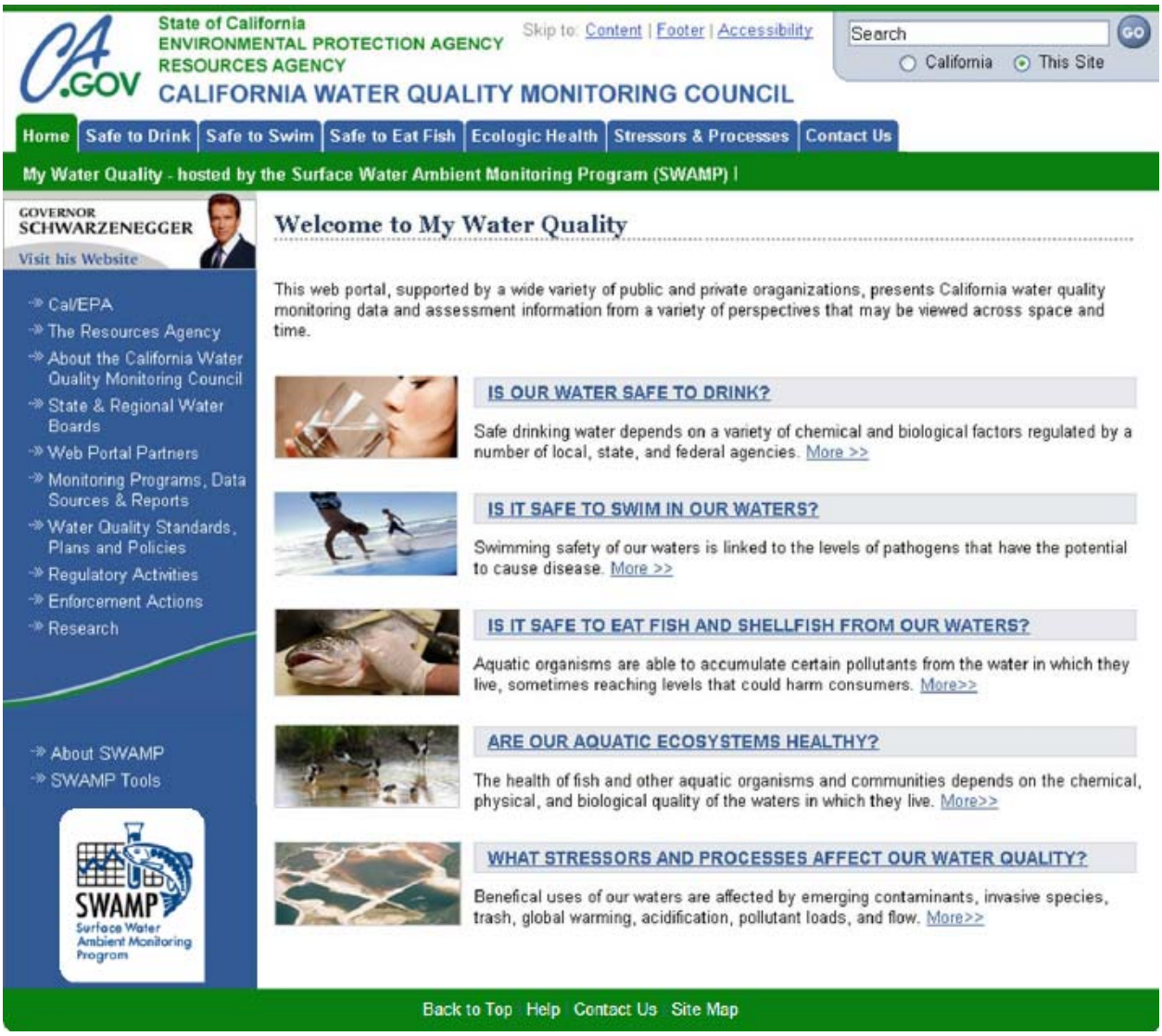


Figure 1. *My Water Quality* home page (www.CaWaterQuality.net)

targeted assessments and summaries of monitoring data. See the "Questions Answered" box on the "Is it safe to swim in our waters?" portal home page, shown in Figure 2 below. The California map on the portal home page may also serve to provide place-based links to these more detailed questions. For example, as shown in Figure 2, the map provides links to the same question areas for each county, ecoregion, and/or other state division.

12) Phrase questions in a straightforward manner as the public would likely ask them. Focus questions on topics of interest to agency decision makers, legislators, and the public.

13) It is acceptable to ask questions that cannot currently be answered directly. In such cases, either present available monitoring and assessment information that is germane to the question or describe the nature of the data gap and what is being done, or could be done, to fill it. Each portal should clearly identify what is known and not known about the water

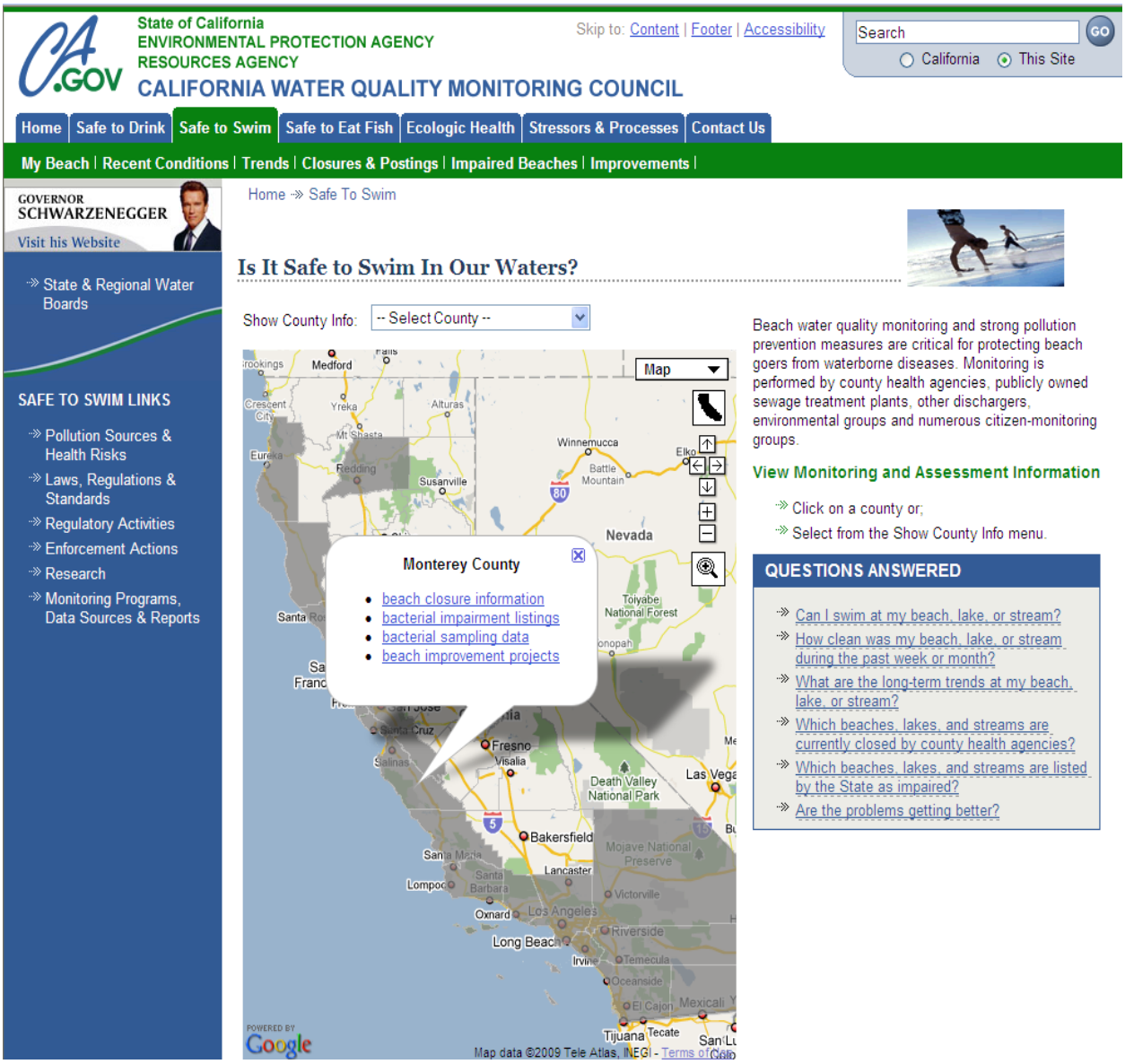


Figure 2. "Is it safe to swim in our waters?" portal home page (http://www.waterboards.ca.gov/mywaterquality/safe_to_swim/)

quality or aquatic ecosystem health theme, with the purpose of identifying, focusing, and motivating efforts to improve monitoring and assessment programs.

14) Present multiple ways to view and interpret monitoring data by including different assessments made by appropriate agencies and organizations (for example, report cards, numbers and trends of exceedances, derived risk measures, indices of habitat or ecosystem health, neutral data summaries). If multiple reputable assessment approaches or thresholds have been published, each should be presented. The portal should explain the difference between the assessment perspectives and their relevance to the portal's questions in terms the public can readily understand.

15) Clearly communicate who is responsible for the monitoring programs and assessments presented in each portal map or data display, why each assessment has been made, its relationship to each question in the portal, and what decisions the assessment supports (see guideline #14, above). Displaying logos of the responsible organizations on the pages where their work resides is encouraged.

16) One or more statewide assessment perspectives should be presented whenever possible. Data gaps and uncertainties should be clearly described (see guideline #13, above).

17) On the home page or in a prominent manner, each portal should communicate that it is a work in process, initially showing what data are readily available, with the goal of adding information as it becomes available.

- Throughout the portal, highlight where data are not being collected or where data are being collected but not currently being compiled.

18) Provide definitions of technical terms in the form of pop-ups or links to pages that present appropriate background information.

19) Include background information on applicable laws, regulations, standards, policies, guidelines, regulatory activities, enforcement activities, and research that are appropriate to the theme of the portal. These are featured as links in the left navigation bar.

20) Include information about the sources of water quality and aquatic ecosystem health problems and their associated risks, threats and impacts on human health, natural resources, and/or ecosystems. These are featured as links in the left navigation bar.

21) Include a mechanism to solicit user input and an invitation to provide comments, e.g., "Did this page answer your question?" See guideline #30(d) below. Capture common comments and responses in the portal.

Portal Layout and Format

22) The following portals should be viewed as templates for other them-based portals:

a) "Is it safe to swim in our waters?" (http://www.waterboards.ca.gov/mywaterquality/safe_to_swim/)

b) "Is it safe to eat fish and shellfish from our waters? (http://www.waterboards.ca.gov/mywaterquality/safe_to_eat/)

23) Beginning with the portal main or home page and throughout the portal, emphasize maps and graphic representations of data and assessments in the main page content area.

a) Consistent cartographic design (e.g., colors and symbols) should be used across portals to enhance the clarity of information being presented. For example, red and other warm colors should be used to represent problems, impairments and older

information while green and cooler colors should be used to represent better conditions and newer information.

b) Included legends to provide keys to colors and symbols used in maps.

24) Background information is featured as links in the left navigation bar and as hyperlinks within the main page content area.

25) Wherever possible, allow the user to access and download the raw monitoring data on which the assessments are based. For example, the Trends page of the portal "Is it safe to swim in our waters?" (http://www.waterboards.ca.gov/mywaterquality/safe_to_swim/trends/) and the Data & Trends page of the portal "Is it safe to eat fish and shellfish from our waters?" (http://www.waterboards.ca.gov/mywaterquality/safe_to_eat/data_and_trends/) provide direct access to bacterial indicator and fish tissue data, respectively. Adding a link to download these data (e.g., as an Excel spreadsheet) for a selected location or area would further improve this feature. Examples of such downloads are on the SWAMP-Moss Landing website at http://swamp.mpsl.mlml.calstate.edu/online-data/year-1-lakes-fish-contaminant-study. Note that the spreadsheets provide filtering tools for each column heading.

26) Use consistent units, scales of measurement, and chemical names throughout the portal. Metric units are expected, unless English units are normally used for the theme.

27) Where possible, use page formats and colors similar to those of existing *My Water Quality* portals to provide a consistent look and feel.

28) Portal content should strive to be accessible to persons with disabilities, so as not to interfere with an individual's ability to obtain and use information quickly and easily. For guidance, see http://www.webtools.ca.gov/Accessibility/.

29) Links to web pages that are outside of the portal should do so by opening a new window.

30) Include the following core page features on all portal pages:

a) A link to return to the main *My Water Quality* home page (www.CaWaterQuality.net), thereby providing access to the other portals. In the portals "Is it safe to swim in our waters?" (http://www.waterboards.ca.gov/mywaterquality/safe_to_swim/trends/) and t "Is it safe to eat fish and shellfish from our waters?" (http://www.waterboards.ca.gov/mywaterquality/safe_to_eat/data_and_trends/), this is accomplished via the tabs across the top of the page. Alternatively, one of the My Water Quality buttons may be used for this function.

b) A link to the workgroup information section of the Monitoring Council's page (see http://www.waterboards.ca.gov/mywaterquality/monitoring_council/index.shtml#workgroup). In existing portals, this is done via the left navigation link "Monitoring Programs, Data Sources & Reports".

c) A link to the Monitoring Council information page (http://www.waterboards.ca.gov/mywaterquality/monitoring_council/). In some portals, this is accomplished via the words "CALIFORNIA WATER QUALITY MONITORING COUNCIL" in the banner at the top of the page.

d) A link to the Contact Us page (http://www.waterboards.ca.gov/mywaterquality/contact_us/), which provides information on portal roll-out and a place to ask questions and provide comments. In the some portals, this is done via the right tab at the top of the page.

- An example comment link is "Contact the SB 1070 Coordinator with your comments and suggestions." with "SB 1070 Coordinator" linked to mailto:SB1070Coordinator@waterboards.ca.gov.

Portal Development Process

31) The portal is a product of the theme-based workgroup, with conceptual approval by the Monitoring Council.

a) For new portals, the workgroup is responsible for developing a mock-up, and presenting it to the Monitoring Council for approval, prior to portal development.

b) The workgroup is responsible for maintaining the portal with regular updates as new monitoring data and assessment tools becomes available. To keep the portals efficient and timely, updates should be automated to the extent feasible (e.g., drawing information from a regularly updated data management system), with the goal of presenting information in real time.

32) The Monitoring Council will review and approve questions, assessment products, and portal mock-ups prior to portal development. These should be presented to the Monitoring Council as a mock-up of main portal pages.

33) New assessments (ones not formally made by agencies/organizations) presented in a portal are products of the theme-based workgroup. Monitoring Council review and approval of new assessments is required, especially for those expected to be controversial. A test-phase assessment map or data presentation may be included in a portal prior to full workgroup concurrence if it is clearly labeled as such with a mechanism for inviting comments and suggestions from portal users.

34) Technical issues with the performance of maps and other web page displays are to be corrected prior to portal release. Address any GIS and web standards published by participating state agencies and the California Office of the Chief Information Officer.

35) Consider convening one or more focus groups to review and comment on draft versions of the portal before public release. Members of such focus groups should reflect one or more of the target audiences discussed in guideline #3 above.

Data Management

36) The Monitoring Council has endorsed the use of a distributed data management system, such as the California Environmental Data Exchange Network (CEDEN). The creation of new centralized master databases should be avoided, as they are more difficult to develop and maintain.

37) Data from disparate sources should be brought together by establishing linkages and data exchanges. A goal should be automated real-time data exchange and movement of information to the portal.

38) To ensure continued high quality, monitoring data should reside as close to its source as possible, preferably with the organization that generates the data.

39) For monitoring data generators that lack in-house data management systems, their data may be managed through a regional data center, such as those associated with CEDEN. CEDEN regional data centers currently reside at Moss Landing Marine Labs (MLML), the San Francisco Estuary Institute (SFEI), the Southern California Coastal Water Research Project (SCCWRP), and the University of California at Davis (UCD).

Appendix 4: California Wetland Monitoring Workgroup, Tenets of a State Wetland and Riparian Monitoring Program (WRAMP)

[INSERT CWMW STRATEGY THROUGH FIRST HALF OF P. 12, DELETING “FUNDING STRATEGY” AND ALL ATTACHMENTS]

Appendix 5: SWAMP Monitoring and Assessment Strategy and Assessment Framework

[TBD]